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A Dream Come True

In our issue of March 24, 1927, we wrote a leading article using the caption "Surface in Service." The opening paragraph read:—"If we were asked to enunciate what property of a casting had the greatest commercial importance we should unhesitatingly put forward the claim of the appearance of the skin. Those making die castings or selling the products of the semi-permanent mould, rightly stress the finish of their work. Surely, the time has arrived when a nomenclature should be developed which should erase, once and for all, from the salesmen's vocabulary such expressions as excellent, magnificent, exceedingly smooth, and from the buyers' rotten, appalling, frightfully rough, when speaking of the surface of castings. This property we take to be in the same category as mineralogic hardness, which for many years has been designated by numbers according to Mohr's scale. We envisage a specially-adapted profiling machine which would be provided with a needle of definite hardness, and would give an exaggerated replica of the condition of the surface when pulled along it lightly at a fixed speed, pressing at an angle of, say, 45 deg. The dimensions of the exaggerated jogs so produced would enable one to designate an art bronze surface of the highest quality as, say, No. 1, whereas a steel casting, cast in a poorly refractory sand, would be classed as No. 13."

Thus, after 22 years, we print elsewhere in this issue a description of a simple machine which has every appearance of satisfying the suggestions then made. The Author has established ranges of roughness, but we still adhere to our original suggestion that a simple number starting from one and advancing as a means of indicating the order of smoothness is preferable. While in 1927 we enumerated the advantages of such a machine in connection with shot-blast timing and sand researches, we were then ignorant of still more important applications. It appears that any irregularity in the profile of gear teeth creates noise and this, in the engine room of a ship, may adversely affect the reception of important telephoned directions and so cause disaster. The National Physical Laboratory has done excellent work in overcoming this trouble. We have followed with interest the work of Kayser and others, but in general they have dealt with finer surfaces than as-cast finishes.

Now that a machine has been designed, it should be studied by the industry, and, if thought necessary, modified Then it should be used for experiments designed to improve the appearance of castings. Sometimes, following the mechanised production of castings, surface appearance deteriorates. Yet at the moment only adjectives can be used to express the degree of deterioration. In the earlier leader we suggested "the B.C.I.R.A. should inaugurate a research, augmenting their normal source of funds by an appeal to those people whose very existence depends on that illusionary quality 'finish of surface'." To-day, being an age of committees, the advice now tendered is for the appropriate one to give it the consideration it deserves, and so "concretise" our dream.

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Two New Films

F. H. Lloyd & Company, Limited, James Bridge Steelworks, Wednesbury, have utilised the services of the "Big Six" film unit to produce two further documentary films to follow an earlier one—"A1 at Lloyds." The new ones are entitled "Flawless and British" and "All Star Casting." The object of these films is frankly the promotion of sales, and the viewer, if he is a reasonable individual, will appreciate this direct approach. The works have excellent material by way of plant installations and control methods and proudly they show it. The sole criticism the reviewer would put forward—and this from no narrow-minded approach, is the appearance here and there of the cigarette smoker. Surely the "toucher-up" could eradicate cigarettes, because, as these films are shown all over the world, some difficulty may be created in areas where smoking is forbidden. The pronunciation of the word cupola as cupula needs correcting. Generally speaking, for films connected with the heavy industries, an accent rather crisper than the normal B.B.C. is to be preferred. The outstanding features of the films is that they vividly illustrate the high level of tidiness that can nowadays be achieved in shops which can so easily become chaotic if control be relaxed for but one week. The producer, Mr. Cook, merits full marks for achieving what was no doubt his objective—the inculcation into the mind of the audience of a feeling of complete confidence in the high quality of the output of Britain's largest steelfoundry.

Monolithic Linings for Cupolas

Plastic material for the daubing of cupolas should be used as dry as possible, and particularly well rammed. It is best to use a pneumatic rammer, ramming the material around the template used originally for constructing the first lining. First of all, it is necessary to clean the used surface of the lining, using a chisel to remove any vitrified portions. Then the surface must be well moistened. The composition of the mix should be of the following type:—Four parts by volume of the original material used, one part of high-grade refractory clay, and one part powdered coke. A very small quantity of powdered fluorspar can be usefully incorporated, because this during melting unites with the coke ash and reinforces the adherence of the material. It is also worth while, for increasing the adherence of the patching material, to brush over the carefully-cleaned surface a wash made up from a mixture of 10 pints of water with 2 lb. of soda ash and sufficiently-pure clay to yield a thin paste. These recommendations are from the October Bulletin of the *Centre Technique des Industries de la Fonderie.*

PROFESSOR DR. PISEK has resigned his position as president of the Czechoslovakian Foundrymen's Association and has been appointed honorary president. He is succeeded by Dr. Bedrich Zimmermann, of Prague. Professor Pisek has been president of the Association for 26 years, that is, ever since its inauguration. At the moment he is president of the International Committee of Foundry Technical Associations.

Forthcoming Events

NOVEMBER 15 and 16.

Institute of Physics.

Electron Microscopy Group:—Tuesday: Papers on Electron Microscopy; Wednesday: Symposium on Metallurgical Applications of the Electron Microscope, at the Royal Institution, Albemarle Street, London, W.1, at 10 a.m.

NOVEMBER 16.

Institution of Production Engineers.

Edinburgh Section:—Documentary film, "Mechanical Handling," at the North British Station Hotel, Edinburgh, at 7.30 p.m.

Liverpool Section:—"Air-operated Fixtures," by C. M. P. Willcox, at Radiant House, Bold Street, Liverpool, at 7.15 p.m.

Western Section:—"The Shaping of Steel," by Dr. C. J. Dadswell, Ph.D.(Eng.), M.I.Mech.E., Ing. E.S.F., at the Grand Hotel, Bristol, at 7.15 p.m.

Institute of Vitreous Enamellers.

Northern Section:—"The Use of Titanium Enamels," by H. Symonds, at the Queens Hotel, Manchester, at 7 p.m.

NOVEMBER 17.

Institute of Welding.

North London Branch:—"The Application of Arc Welding to Cranes and Conveyors," by A. T. C. Burrows, A.M.I.Mech.E., at Regent Street Polytechnic, London, W.1, at 7.30 p.m.

Institution of Production Engineers.

Cornwall Section:—"Tin Metal, Mining and Production," by Col. Whitworth and others, at Holman's Canteen, Dolcoath Road, Camborne, at 7.15 p.m.

Institute of Physics

Joint meeting with the Institution of Electrical Engineers. Discussion on "The Education and Training of Technologists," at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, at 5.30 p.m.

NOVEMBER 18.

Institution of Mechanical Engineers

"World Energy Resources and their Utilisation," by A. Parker, C.B.E., D.Sc., at Storeys Gate, St. James's Park, London, S.W.1, at 5.30 p.m.

Institution of Production Engineers.

North-Eastern Graduate Section:—Documentary film, "Mechanical Handling," at the Neville Hall Mining Institution, Westgate Road, Newcastle-upon-Tyne, 1, at 6.45 p.m.

Institute of Industrial Supervisors.

Wednesbury and Darlaston Section:—"Material Handling," by Hartford M. King, at the Works Canteen, Wellman Smith Owen Engineering Corporation, Limited, at 7.30 p.m.

NOVEMBER 19.

Institute of British Foundrymen.

East Midlands Branch:—"Castings from the Customer's Point of View," by W. P. Smith, at the College of Technology, Leicester, at 6 p.m.

Bristol and West of England Branch:—"Gating Systems and the Production of Some General Engineering Castings," by W. Collinge, at the Grand Hotel, Broad Street, Bristol, at 3 p.m.

Institution of Works Managers.

Sheffield Branch:—Discussion on "Recruitment for Management. University Training *versus* Shop-floor Experience," at the Royal Victoria Station Hotel, at 3 p.m.

Making a Large Multi-cylinder Diesel Crankcase*

By J. F. Barnes and F. E. Ironmonger

This Paper details the making of a large multi-cylinder diesel crankcase at the works of Ruston & Hornsby, Limited, Lincoln. The first section concerns mainly the core-making, and was presented by Mr. J. F. Barnes.

PART I—CORE-MAKING

By J. F. Barnes

First, it is proposed to outline what happens when a drawing for a job of this nature is received from the drawing office. After being sent to the foundry-methods department, where all details, such as pattern construction, core-box design, size and placing of runners, etc., position and size of risers and feeding heads are considered, a check-up is made on any difficult locations, such as heavy sections, where chills or denseners will have to be used. All these points, and any others that may arise, are thoroughly examined by the heads of all foundry sections before a real start is made. From the information gathered in this way, the decisions made as to methods to be adopted for moulding and core-making are set out on all drawings as working instructions to the pattern shop.

Unfortunately, space does not allow for any description of the great amount of pattern work involved in the manufacture of patterns and core boxes for this job, but an acknowledgment of the fact that the pattern-makers' skill and craftsmanship play a very important part in the successful production of the final casting must be made.

This crankcase, when cored and ready for casting, contains no fewer than 200 cores, of which more than half have to be lifted by crane. The casting, when cleaned and ready for delivery to the machine shops, weighs 13½ tons. Fig. 1 illustrates the casting from two angles. The complicated coring is evident.

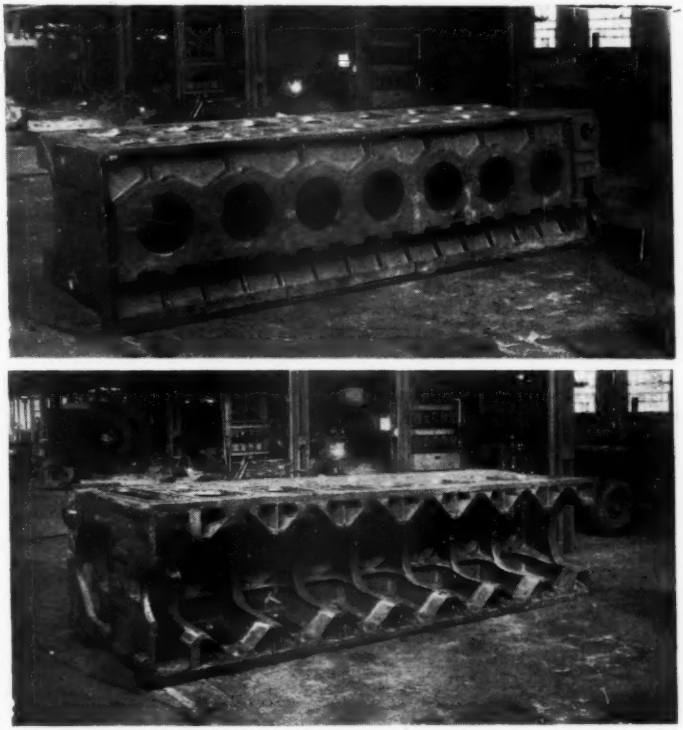

FIG. 1.—TWO VIEWS OF THE MULTI-CYLINDER DIESEL CRANKCASE.

Making Some of the Larger Cores

All labour used in making the cores is female, and while some of the operators have had a fair amount of experience, others have had very little, so close supervision is necessary. The sand used is mainly Southport

*A Paper presented to the Lincoln Section of the East Midlands Branch of the Institute of British Foundrymen. It was announced at the June Conference that the Authors of this Paper had been awarded a Diploma.

Multi-cylinder Diesel Crankcase

sea sand, mixed with a core compound of a modified semi-solid type, that is to say, midway between a semi-solid and a cream. Its properties are:—*Permeability*: green, 150; dry, 170. *Green compression*, 1.9; and *dried strength*, 900 to 1,000 lb. per sq. in. This sand is a special mix and is only used for the larger cores. The reason why it is not in general use for all cores is because of its high green strength. It is an ordinary sea-sand mix with no clay added. Some time ago dried Mansfield or Worksop sand was added, but it was found that this gave a sand too much like putty, which was very difficult to ram closely. Unless this sand is rammed closely, a very poor finish results on the casting, so the red sand was cut out altogether and better results have been achieved. The proportion of compound used is one part of compound to 30 parts sand, or 3⅓ per cent.

Most of the core boxes are made wash-tub fashion, that is, all loose sides in an outside frame. The first core to be dealt with is what is called the "timing core." Here it might be as well to mention that there is a simple code name for each core so that it can be easily identified. This particular one is shown in Fig. 2.

FIG. 2.—TIMING CORE MADE IN HALVES AND ASSEMBLED BEFORE INSERTING INTO THE MOULD.

FIG. 4.—CRANKCASE CORE SHOWING OVERHANG, WHICH NECESSITATED TWO GRINDS.

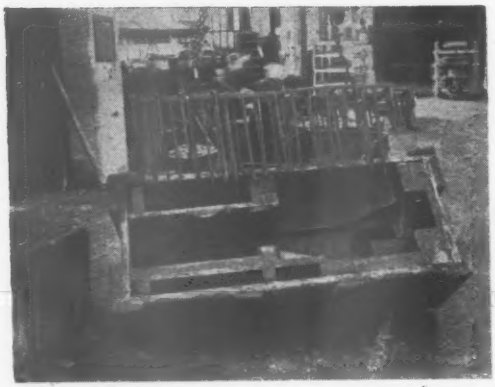

FIG. 3.—HALF CORE BOX AND GRID FOR TIMING CORE.

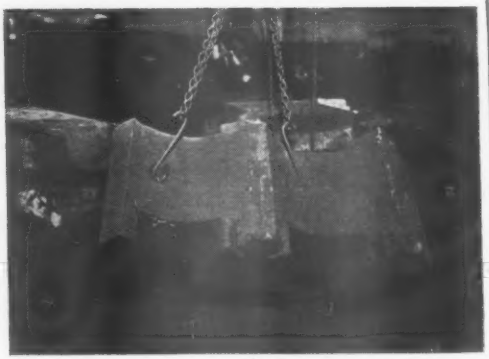

FIG. 6.—JACKET CORE COMPLETED.

This core, as shown, is split on the joint; each half weighs about 13 cwts. Fig. 3 shows the box with the core iron ready to be used. This is not a difficult core to make, just a straight ram-up with lifters and loose irons placed in all awkward spots. Blocks are rammed in the centre to be taken out later and their space filled with coke breeze after well wire-venting the rammed sand. This venting is most important, as it is not easy to decide how much coke is to be used, because if too much is put in, the core will most likely sink or sag. It is necessary, therefore, to use coke with moderation and make up with liberal venting of the sand before-

FIG. 5.—GRIDS FOR THE CRANKCASE CORE.

FIG. 7.—JACKET CORE IN THE MAKING.

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hand. Substitutes for coke have been tried, one being to use ordinary wet sea sand instead, but, when the water dried out, the sand shrunk, leaving a cavity. When casting, the weight of the metal squeezed-in the sides of the core, resulting in a badly-swollen rib. With this core it was found that quite a lot of sag or shrinkage took place, and this was ascribed to the heavy core iron; it was therefore decided to pack the iron before putting on the plate, so that the iron could not drop at all, and this was found to cure the trouble. On all the large boxes ¼ in. is allowed on joints in case of sagging.

This core is not so easy to make, because, as shown in Fig. 4, it has 7-in. overhang, and it was found that the ordinary core iron was not satisfactory, so it was decided, and with some success, to use two irons, shown in Fig. 5. The first one was placed under the rib with the prods downwards, the other over the rib with prods upwards. The two were bolted together in two places, using fishplates, bolts and distance-pieces in between. Coke was used for venting, some being placed in the bottom iron after very thorough wire-venting of the rammed sand; this coke bed was connected to the other bed in the top iron and both were led off to the main print. There were 16 halves like this, each weighing about 6 cwts.

Jacket Core

This core, shown in Fig. 6, is really a lightening core which fits round the water-jacket. Here again, the grid has to be made somewhat differently. As shown in the illustration there is quite a long overhang, so it was decided to put the frame of the grid halfway down the box with the prods downwards and with loose irons cast in the frame to bend over to take this overhang. Coke was used again for venting and all beds were led off to the main print. There are eight of these jacket cores to one set, but they are all shaped slightly differently, so loose change pieces are used in the box to make these alterations. Each of these jacket cores, shown in the making in Fig. 7, weighs 6 cwts. 2 qrs.

FIG. 9.—CYLINDER, OR BARREL, CORES.

Jaw Cores

This core, shown in Fig. 8, forms the cylinder face and there are eight of these to each set, each being different from the others. The making of these is not

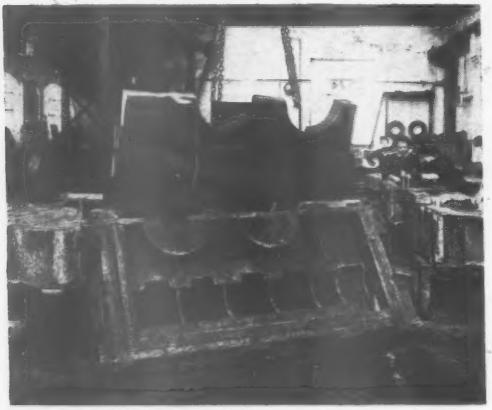

FIG. 8.—JAW CORE FORMING THE CYLINDER FACE.

FIG. 10.—SPECIAL METAL-FACED JIG FRAME FOR DRESSING A CORE.

FIG. 11.—METHOD OF LOADING CORES ON TRUCKS FOR DRYING.

too difficult, although there are many bits and pieces to be supported by loose irons or lifters. As shown in Fig. 8, chills are placed on the flat face, as there are widely-varying sections of metal at this point and something has to be done to counteract and prevent shrinkage.

Barrel Cores

It is not intended to describe in detail the cylinder, or barrel cores, which are the plain half-round cores shown in Fig. 9; these are jigged and fitted together. There are sixteen halves to one set, each half weighing 2½ cwts. Here again, chills are used to accelerate the freezing of the heavy-section backing bosses for the cylinder-head bolts. Most of the remaining cores are not very big and vary in weight from 1½ cwts. to a few pounds.

With regard to the allowance of ⅛ in. made on the joints of most large core boxes to counteract any sag which may take place, this has to be controlled and most of these cores have to be rubbed-down to an accurate size in a special jig which has metal facings on the joint; this is shown in Fig. 10. Finally, they

FIG. 12.—GENERAL VIEW OF THE CORE SHOP, SHOWING A RANGE OF CORES.

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must be checked to make sure that they are correctly to size before being passed on to the moulders. This part of the job is done by men as it is considered this jigging and dressing is most necessary, more so now than ever before, as machine shops are continually demanding closer dimensional tolerances. Most cores, therefore, are placed in a jig and the joint is cleaned, or rubbed-off as required. Even after this operation, the two large crankcase cores are placed together and checked all over for sizes, etc. This also applies to the timing core which was shown in Fig 4.

All blacking, painting and finishing is done by the girls and a very high standard of finish is demanded before cores are allowed to leave the shop. Blacking sprays are used, as it is found they permit the liquid blacking to penetrate into recesses better than when a brush only is used. The whole core after being sprayed is gone over with a brush. The girls working on these jobs are all on piecework.

Method of Drying

The cores are built up on trucks, as shown in Fig. 11, cages being used to build the load to a height and so get a substantial number in the stove at each time. Coke fire-boxes are used to produce the necessary heat. The time of drying is seven hours at 230 deg. C. (450 deg. F.). Here again the management has learnt from experience. At one time an attempt was made to dry in about 3½ hours at a much higher temperature, but it is now known that a longer period and lower temperature gives much better results with heavy section cores. A photograph of the shop in which all this work is carried out, with a selection of the cores of different shapes and sizes which are made, is shown in Fig. 12.

(*To be continued.*)

Nickel Bulletin, October

This issue is devoted entirely to abstracts from recently-published material. The variety of subject matter is seen in the brief selection given below, all of which are of interest in their respective fields:—Induction brazing of nickel-alloy permanent magnets, spot tests for nickel-alloy steels, nickel-containing materials vs. sterilizing solutions, and iron in cupro-nickel condenser tube alloys. Copies may be obtained free of charge on application to The Mond Nickel Company, Limited, Sunderland House, Curzon Street, London, W.1.

Record Production at G.K.B.

At the East Moors, Cardiff, works of Guest Keen Baldwins Iron & Steel Company, Limited, two notable records have just been made. For the four-week period of October, the steel-ingot production was 50,367 tons and the 51,208 tons of ingots were put through the rolling mills. This is the first occasion on which an output of over 50,000 tons has been attained by both departments.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

MELTING EQUIPMENT

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—We have read with interest last week's article by A. W. Brace, A.I.M., and must draw attention to the incorrect information given in respect of our furnaces on page 544. The oil consumption for melting aluminium is quoted as 4½ galls. of oil per 100 lb. of metal melted, which the Author states "at present means the cost of melting is about 3d. per lb." What in fact the Author should have stated was—that the oil consumption was about ¼ gall. per 100 lb. aluminium melted; therefore the melting cost is about 4½d. per 100 lb. metal melted.

We should be obliged if you will correct the above mis-statement, as the figures quoted in the article are, to say the least, a slur on the thermal efficiency of our furnaces, and a gross mis-statement of the actual facts. No doubt, at the same time, you will draw the attention of the Author to our remarks, and should he require proof of the above statement we shall be only too pleased for him to witness a demonstration and check the figures.

Yours, etc.,

Sklenar Furnaces, Limited, F. P. GOLBY
East Moors Road, Cardiff. (Director).
November 7, 1949.

KIBBLES

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—With reference to your note on "What is a Kibble?" on page 558 of the November 3 issue of the FOUNDRY TRADE JOURNAL," Hackh's "Chemical Dictionary" defines kibbling as "broken into small lumps about 1 cm. diameter."

In my youth, on an estate water mill in North Wales, the term was used for the coarse grinding of oats, etc., so the term is evidently loose according to the product dealt with. As an instance, we use aluminium sulphate for water treatment; this is described as "kibbled" and has pieces ranging from ¼ in. to relatively-large masses some 3 in. by 2 in. by 1½ in. The term is thus not merely local.

Yours, etc.,

4, Victoria Street, A. LEWIS ROBERTS.
Shrewsbury.
November 5, 1949.

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Referring to your note on the meaning of the word kibble in last week's issue of the JOURNAL, you may care to know that in a glossary of mining terms mostly used in the Cornish mining districts and published in "Gazetteer of Cornwall," by R. Symons, C.E., in 1884, "kibble" is defined as "a bucket usually made of iron, in which the ore, etc., are drawn to the surface."

Yours, etc.,

"Trevose," 5, Atlantic Terrace, T. R. HARRIS.
Camborne, Cornwall.
November 5, 1949.

Institute of British Foundrymen — *Scottish Branch*

"Science in Hand with Labour"

Mr. R. S. M. Jeffrey's Presidential Address

At the October meeting of the Scottish Branch of the Institute of British Foundrymen, Mr. R. S. M. Jeffrey, B.Sc., F.R.I.C., delivered his presidential address, in the course of which he said:—

At the commencement of a new session I should like to stress yet again the importance of "Science hand in hand with Labour." Having spent my working life with a foot in both camps, this is a subject of paramount interest to me and, I am sure, to most of you. The powerful alliance of science with labour was the objective of the founders of our Institute. Throughout the years of the Institute's activity, much has been done to foster it, our Scottish Branch playing no small part. Other industries have not neglected their research and scientific development, indeed it is only within recent years that the Research Association of our industry has attained a status commensurate with our industry's importance in the nation's affairs.

Research Activities

We on the technical side are proud of this achievement of the British Cast Iron Research Association and are greatly appreciative of the new knowledge which has been made available to us. Much more is required to elucidate so-called ordinary cast iron which is perhaps the most complex of all commercial alloys. Fundamental investigations are proceeding on such aspects as slag/metal reactions, graphite formation and the solidification process in the iron/carbon/phosphorus system and I understand that work of more immediate interest to the light-castings industry is contemplated by the Association dealing with the problems of fluidity, shrinkage and porosity, also the vitreous enamelling of cast iron. While appreciating the value of research past and present, I consider that this Institute, in providing a common meeting ground for technical and practical men, a forum for the discussion of all aspects of our trade, is performing at the present time a function of perhaps greater national importance. In this regard, I would refer to Sir Henry Tizard's presidential address to the British Association in which he stated that no new scientific discovery is likely to have so quick and beneficial an effect on British industry as the application of what is already known. Productivity is far lower than it would be if the results of past researches were more resolutely and continuously applied. Here then is the call for science to go hand in hand with labour. It is questionable whether even in the war years the necessity for greater, cheaper and better-quality production was more urgent. It was perhaps more obvious then and of little use to hide one's head from the realities, a subterfuge which has been so widely practised in the recent years.

Productivity

To attain this improved productivity there are various requirements. Primarily, I would stress personnel. Our industry requires the best both on the practical and technical side. Later to-day, we are to be privileged to have an address by Dr. Cormack on "Apprentice Training in the Foundry." As he has spent many years in applying the subject on which he is to give his considered opinion, I am sure he will add something of value to this very difficult and controversial subject. Much has been done by some firms to encourage their young men to do more than "serve their time," on the moulding floor or work bench and so fit themselves for advancement to fill the positions of foremen on which so much responsibility rests. The fact that only a small percentage of our apprentices, particularly on the moulding side, acquire such training, is a criticism not only of the lads themselves, but also of the facilities available.

Much has been said about the working conditions in foundries, but the installation of equipment for heating, ventilation, dust extraction and the provision of ablution and canteen facilities have done a great deal recently to improve conditions. Improvement is still needed, yet most of us have spent our working life in a foundry and our expectation of life has not visibly suffered. The firm with which I am associated has had many men who have served for 50 years and over. This then is our approach to the new personnel which we are in so much need of. We can offer an interesting, a satisfying and healthy job, with good prospects of advancement to the youth who is prepared to apply himself to the technical or practical field.

Discussion with the man on the job stimulates thought and many ideas are forthcoming, particularly where payment by results is in operation. If alteration to procedure is discussed and understood by all, greater co-operation is obtained and a larger measure of success is likely to be achieved. A less personal but nevertheless effective contact between management and man is the "information board" showing production figures and scrap analysis; sited prominently on the foundry floor, this arouses interest, points to weaknesses and improves productivity.

There is, however, a considerable factor in the problem of obtaining maximum effort which is to some extent outside our control. I refer to the incentive to

Mr. Jeffrey's Presidential Address

acquire not money, but the goods which money could once buy. On the workers part, this meant good food, a house of their own, perhaps a car. On the employers part, new buildings, new plant and patterns. With taxation as it is to-day, both are largely frustrated. However, we hope that in the near future greater effort will earn greater reward.

Standardisation

One of the first queries in a foundry on any new job is "how many off?" The number required largely determines the permissible expenditure on plant and whether it will be a floor, machine or mechanised-plant job. By closer co-operation between the architect, designer, engineer and foundryman, the often needless variation in castings can be avoided. The automobile industry has benefited by recent standardisation, but much more is required in other branches of industry where frequently there is difficulty in obtaining adherence to agreed standards.

Mechanisation

Ruskin has said:—"Of all wastes the greatest waste that you can commit is the waste of labour." The use of machine power to avoid unnecessary physical labour and the replacement of batch production by continuous production, can be greatly developed. The principles are not new and have been accepted by many progressive firms in the country, but in this field we have allowed the go-ahead American to outstrip us. He has been more enterprising and imaginative. We have been too long content to jog along at a settled pace. Last year, I had the opportunity of visiting a few of the foundries in the U.S.A. engaged in light-castings production. They have developed the use of mechanised aids to a very high level and I would refer briefly to a few of these. In metal melting I was particularly impressed by one mechanical charger serving four cupolas. Operating on double shift, two cupolas were in use daily. About 270 tons were melted per 24-hr. day, the charging being carried out by four men only, two per shift, each increment of the charge being weighed or measured. Sand ramming was largely by the Sandslinger. Variations of the machine as we know it here were used. The "Speedslinger" used for bath production was delivering approximately double the quantity of sand which we are accustomed to handle. The auxiliary plant had, of course, to be increased in proportion, and though the high production obtained from one unit was most interesting, the advisability of concentrating so much man-power round a single unit appeared questionable.

Fittings were produced using a "Swingslinger," this unit operating continuously and entirely automatically. The output of this unit was 6 to 24 castings per minute, depending on size, a standard box being used. In contrast with these plants handling very large tonnages of sand, was the centrifugal process using metal moulds with sand entirely eliminated. This process was being applied there to light-iron pipes and was attaining output per man considerably in excess of our traditional methods. The foundry conditions were similar to our mechanised plants. Technical control was generally applied and the productive effort was great, justifying high rewards. These highly-productive plants, both in their planning and operation, are the outcome of scientific and practical collaboration and the results they have achieved justify the means. We can learn much from a study of such methods.

Costing

Finally, I should like to refer to the necessity for greater attention to costing. Standardisation and mechanisation, providing greater quantity production, do not necessarily provide a cheaper product, because power, depreciation and maintenance become considerable factors. The capital outlay on plant is obvious, but less obvious is the expenditure during the initial trial period on the training of personnel. Each operator requires to become a specialist at his particular job and his experience is dearly bought. Only by careful study and costing of each operation can the final cost of the product be controlled. Since our economic salvation is dependent on the price of our product being attractive, more intensive application of costing, both departmental and job costing, is required to improve efficiency. Each of us engaged in our various capacities in the foundry is dependent on a strong progressive industry for our livelihood. To ensure this we must have co-operation at all levels in the application of new processes, installation of new plant, and in the economic operation of both.

Latest Foundry Statistics

On a monthly assessment, employment in ironfounding has again decreased slightly and is now less than a year ago. On September 10 the total of all workers was 145,502, as against 145,603 in August and 146,558 a year ago. During the month, male employment decreased by 52 and female by 49. Employment in the steel foundries was better during the period under consideration; on September 10 it stood at 19,168, a net gain of 366, made up from 383 more men and a loss of 17 women. The weekly average output of steel melted for the making of castings advanced in September to 1,630 tons, as against 1,470 tons in August and 1,440 tons a year ago. Thus, using these figures, there has been an increase in employment of just under 2 per cent., associated with an added production of over 10 per cent. Is this the result of the productivity drive? These figures have been abstracted and deduced from those set out in the October Statistical Bulletin of the British Iron and Steel Federation.

SIR LAWRENCE EDWARDS, chairman and managing director of the Middle Docks & Engineering Company, Limited, South Shields, has been elected president of the Shipbuilding Employers' Federation.

Speed of Loading in Tensile Testing of Cast Iron*

Small Influence in the Range Selected

By M. Gelain

The Author deals with a good ordinary high-strength cast iron having a breaking strength of the order of 15 tons per sq. in. The iron was made by the *Société des Hauts-Fourneaux et Fonderies de Pont-à-Mousson* in the electric furnace and cast green to bars at 30, 20, and 12 mm. dia. and 500, 400 and 120 mm. length. The chemical analysis ran: T.C., 3.32 per cent.; Si, 1.88; Mn, 0.73; S, 0.05; and P, 0.15 per cent. Four test pieces with filleted heads were machined from each bar of 30 and 20 mm., and three from each bar of 12 mm. Thus there were available 103 test bars of 20 mm., 107 of 12.5 mm. and 108 of 5.64 mm. For each size of bar, three loading speeds were used as follows:—v1, 0.8 kgm. per sq. mm. per sec.; v2, 1.6 and v3, 3.2 kgm. per sq. mm. per sec. These correspond, for the iron studied, to testing times ranging around 31, 15, and 8 seconds. The tests for the 20 and 12.5 mm. bars were carried out at the *Centre Technique*, and the 5.64 mm. bars by Pont-à-Mousson. The results obtained are given below:—

Speed.	Test bar 20 mm.			Test bar 12.5.			Test bar 5.64 mm.		
	V 1.	V 2.	V 3.	V 1.	V 2.	V 3.	V 1.	V 2.	V 3.
No. of tests	32	36	35	36	35	36	37	36	36
Average strength, kgms. per sq. mm.	22.6	22.5	22.8	24.5	24.9	24.7	26.6	26.7	27
Spread of results	4.7	4.1	3.8	3.3	3.6	3.7	4.9	3.9	4.6
Mean quadratic variation	0.78	0.89	0.86	0.78	0.86	0.70	1.02	0.73	0.99

V 1—0.8 kgm. per sq. mm. per sec.; V 2—1.6 kgms. per sq. mm. per sec.; V 3—3.2 kgms. per sq. mm. per sec.

The Author points out that from a simple examination of averages it is difficult to draw a clear conclusion, but it can be stated from the fact that the mean figures obtained with speed v3 are all higher than those resulting from speed v1, and there is a tendency towards an increase in strength as the speed of loading increases. However, despite the relatively-large amount of data available, it is thought that it would be interesting to see in what way statistical methods would aid judgment.

Adjustment to Standard

For each series of tests, the adjustment to the law of standards has been carried out by the "Henry" system. The examination of the graphs shows that, on the whole, the adjustment is very satisfactory. It therefore seems that in each series the measurements are divided according to the law of chance and are thus verified that:—(1) The filleted-head test piece, which is that laid down in specification number A-32,101, completely satisfied the tensile-test requirements. Every test piece without exception broke normally in the cylindrical part; and, (2) tensile testing using such a test piece is of such a nature as to give a significant characterisation of the iron—its tensile strength.

Under these circumstances, by taking for the value of the tensile strength the average of each series, one can calculate, for each case, the error in relation to the middle value (presumed to exist) so that there is a 95 per cent. chance of not overstressing. The following were found successful for each speed of loading on the various diameters:—

	Tensile strength (kgm. per sq. mm.)		
	V 1	V 2	V 3
For diameter 20 mm. ..	0.27	0.29	0.29
,, ,, 12.5 mm. ..	0.26	0.29	0.23
,, ,, 5.64 mm. ..	0.33	0.24	0.33

In other words, there is a 95 per cent. chance that the middle value of each series would be contained within the following respective limits:—

	Tensile strength (kgm. per sq. mm.)		
	V 1	V 2	V 3
Diameter 20 mm. ..	22.6 ± 0.27	22.5 ± 0.29	22.8 ± 0.29
,, 12.5 mm. ..	24.5 ± 0.26	24.9 ± 0.29	24.7 ± 0.23
,, 5.64 mm. ..	26.6 ± 0.33	26.7 ± 0.24	27.0 ± 0.23

It will be noticed that the reliability intervals of the averages interchange in certain cases.

Continuing, the Author shows that an analysis of the variation permits the postulation of a more precise statement. There is for each size of test piece three classes of test, each corresponding to a different loading speed, and in each case 32 to 36 measurements. If the relationship is made of the inter- and intra-classes, the following figures are shown:—1.25 for the 20 mm. test piece; 2.31 for the 12.5 mm., and 1.80 for

(*Continued on page 574.*)

*Paper presented at the 23rd Congress of the *Association Technique de Fonderie* in Paris.

Publications Received

Organic Bonding Materials for Foundry Cores and Moulds—A Survey of the Literature on Gases, Vapours and Fumes Evolved Therefrom. By W. M. Lord. Published as Report No. J.S.C./4/1 by the Factory Department, Ministry of Labour and National Service, Artillery House, Artillery Row, London, S.W.1.

During its investigations, the Joint Standing Committee on Conditions in Iron Foundries decided that the members should be furnished with a survey of the published literature on organic core binders, Mr. Lord has accomplished this task very well. Organic chemistry not being the reviewer's *forte*, here and there he confesses his inability to follow the text. Yet for the major part he found the matter exceedingly interesting. Whether Mr. Lord's Paper will help the Committee in its laudable endeavours to eradicate fume and dust from the industry is doubtful.

To the reviewer's mind, this is a question of the proper engineering of foundries. It will be simpler to eradicate the fume nuisance at source than satisfactorily to sample the fume existing at 6 in., 1 ft., 3 ft. or 12 ft. The object of this research was, however, to find whether there are available any materials which are fumeless and harmless. If the Committee succeeds in its quest it might pass on the information to the fish-frying industry, as it may also solve their problems! A limited number of this valuable document is available to our readers on writing to Mr. W. B. Lawrie, at the address cited above.

A Guide to the Writing of Business Letters. Published by the Training Department, T.I. (Group Services), Limited, Broadwell Road, Oldbury, Birmingham.

Much good advice is given in this 16-page pamphlet, but the writer has omitted one aspect which is of importance, and that is that an effort should be made to avoid egoism, using the word to include relationship to "we" as well as "I." For instance, on page 15 of the booklet the author has made a transcription of a badly-written letter printed on page 14. The poorly-written letter is in one way better than the amended version, as the recipient at least comes into the picture, whereas the "good" is vitiated by the stressing of the "we" throughout. A writer of good letters should know how to avoid this. Again, surely courtesy demands that the sender of a cheque should be thanked, a matter wrongly omitted for the sake of brevity. Beyond this criticism, the reviewer endorses wholeheartedly the six precepts enunciated.

The Public Supervision of the Iron and Steel Industry. Published by the British Iron and Steel Federation, Steel House, Tothill Street, London, S.W.1.

At this time it is particularly appropriate to remind the public that national supervision of an industry can be quite effective without being operated under public ownership. This pamphlet does it by a plain unvarnished recital of the creation and operation of the now defunct Steel Board.

House Organs

Albion Works Bulletin. Vol. 3, No. 4 (October). Published by John Harper & Company, Limited, Albion Works, Willenhall, Staffs.

This issue announces that Mr. D. H. Lewis, Mr. A. L. Retallack and Mr. J. E. Spear have been appointed directors of the company. All these gentlemen are employees of the company. While but few firms make such thin-sectioned castings as Harper's, the question of breakages during handling has been brought up, as the extent has assumed such proportions as can no longer be neglected. Absenteeism has been diminishing and the Meehanite foundry registered 2.42 per cent. in September.

"600" *Magazine.* Vol. 23, No. 108. Published by George Cohen, Sons & Company, Limited, Broadway Chambers, Hammersmith, London, W.6.

This issue contains illustrated descriptions of the new pattern shop at K. & L. Steelfounders and Engineers, Limited, Letchworth, and of the new foundry of Metalclad, Limited, at Morriston. Both these concerns are, of course, in the "600" group of companies. There are the usual funny pictures—a few "priceless," and many anecdotal paragraphs—some a little "near the knuckle."

Broomwade News Bulletin. Vol. 12, No. 8. Issued by Broom & Wade, Limited, High Wycombe.

This issue tells, *inter alia*, of the recent overhaul of a compressor installed in 1913 in the works of William Beardmore & Company, Limited, of Park Lead Works, Glasgow. It is thought by the makers to be the oldest "Broomwade" compressor still in service. If there is an older one, then a letter to us or to High Wycombe would be appreciated.

(*Continued from page* 573.)

Speed of Loading in Tensile Testing of Cast Iron

the 5.64 mm. test piece. If one relates them to Snedecor tables with 0.01 as the factor of probability, it will be found that not one of these relationships is significant. From a statistical examination it can be stated that with the data available, there is 99 per cent. chance that the variation between the classes, due to differences in speeds of loading, would not be statistically different from the variation within the classes, due mainly to the heterogeneity of the iron.

Finally, a confirmation of this conclusion has been obtained by breaking 51 test pieces of 12.5 mm. dia. taken from the same lot of bars with a range of widest speeds of loading possible; practically twenty speeds, ranging from 0.4 to 4.5 kgm. per sq. mm. per sec., corresponding to times of testing of the order of 60 secs. to 5 secs. Plotting the loading speeds as abscissae and the tensile strengths as ordinates, there is obtained a cloud of points where there appears to be no index of correlation, which confirms the calculation of the coefficient (r) which is found to equal 0.020 and of which there is no necessity to confirm since it has no real significance.

I.B.F. Conference Discussion

Cupola Charge Materials

Report and Recommendations of Sub-committee T.S. 27 of the Technical Council

When the Paper* "Cupola Charge Materials, the Report and Recommendations of Sub-committee T.S. 27 of the Technical Council" was presented by Mr. W. W. Braidwood (chairman of the sub-committee) at the Annual Conference of the Institute of British Foundrymen at Cheltenham Spa, Mr. Gresty, chairman of the session, described the report as a good example of committee work. He suggested, however, that there would probably be a number of points for discussion, some of them, no doubt, controversial in character.

Over Elaboration

MR. H. J. YOUNG, opening the discussion, said he regretted to say that this Report appeared to him as a mountain of warnings and remedies, on the pattern of a popular encyclopædia of medicine. While men of experience would ask what it was all about, others less experienced would be led into the adoption of unnecessary precautions or else would be appalled by the prospect and attempt nothing. Without contributing something as lengthy as the Report itself it was impossible to deal with it in detail. To select a few points—he himself in recent times had been driven to the use of mixtures containing very high percentages of scrap iron, but he had taken none of the measures recommended in the Report and had come through successfully. As for altering the riser-ing and running of the castings, the suggestion was fantastic. Also, he had been landed with many tons of the filthiest scrap iron he had ever seen, thin, small, very rusty and scaly. That had now all been consumed, the only alteration to practice having been the addition of an extra half-shovelful of limestone to each cupola charge. The above remarks applied to the production of hundreds upon hundreds of castings of the highest class, many machined all over, many pressure-tested. The sub-committee appeared not to know that France, America and ourselves made millions of steel-mix cast-iron shells during the first world war, or that the problem of melting heavy-steel-containing mixtures was finished and done with thirty years ago. Oliver Smalley was then melting up to 75 per cent. steel mixes. He (Mr. Young) had melted tons of 25 per cent. steel mixes—containing from 0.5 to 2.5 per cent. of silicon—every working day for thirty-five years, and without adopting any of the remedies suggested here. In 1923, he published what he believed was the first reference to and description of the sulphur-manganese balance. No formula was necessary; and no analysis either, except for "borderline" work. Steel-mix irons had been produced in great quantities in China and India to instructions contained in short letters and cables sent to the foundries concerned. Any foundry could be launched on steel-mix iron production. Of course, if a foundry possessed a laboratory together with volume control, weighing machines and the labour and the knowledge, then what was a simple business could be complicated *ad nauseam*, just as one man could obtain reasonably good photographs with a "Brownie" camera while another might employ an instrument requiring much skill to use and very fine results to justify.

The Report stated that where the characteristics of sand-cast pigs were judged by fracture, difficulty in the use of machine-cast pigs could be avoided by adopting a control based upon carbon equivalent. He would ask the sub-committee how many foundries normally addicted to "fracture-gazing" have means of ascertaining carbon-equivalent or the knowledge to apply the information is supplied. He himself had done no fracture-gazing since 1911, but had not yet adopted a control based upon carbon equivalent. It was the last thing he would recommend to the ordinary ironfoundry, and over 75 per cent. of the foundries of the country fell into that category. The Report gave the impression of striving to "sell" the ideas of inoculation and de-sulphurisation. Both are unnecessary and even to be avoided, unless a foundry is working on Meehanite lines, or had defined objectives in view. Granted that some founders dissolved away their cupola-linings with de-sulphurisers for no better reason than men at one time wore out their trousers pocket carrying around a raw potato. One explanation of the pedantic tone of this Report lay perhaps in the fact that its bibliography was started at the year 1936—at least twenty years too late! Thus, the Report had missed the work and the researches of Stead, Turner, Moldenke, Meehan, McLain, Smalley, Diefenthaler, Wüst, Cook, Hurst, Shaw and many others who put the whole of these matters on a sound practical footing years before 1936. Finally, he would say to all ordinary foundrymen, there *was* no great difficulty or danger in melting steel in a cupola. There *was* no need to de-sulphurise or inoculate. There *was* no formula necessary to calculate the manganese. All a foundry required was proper cupola-practice—and it needed that only, steel additions or no steel additions—plus some advice as to the right mixture to use. Analysis was wanted only of what went into the cupola, and the

*Printed in the JOURNAL, July 7, 14, 21 and 28.

Cupola Charge Materials—Discussion

pig-iron makers supplied it free of charge. His advice was: "*Make sure of what goes in and how it goes in, then what comes out will be just right for any ordinary ironfoundry.*" It was all perfectly straightforward; it was all perfectly safe. Complicate the issue with a mass of nostrums and precautions, and anything might happen; in any case it became both costly and intricate instead of cheap and simple.

MR. BRAIDWOOD said that Mr. Young had overlooked one important point. In every case described, Mr. Young was in control! The Report had been written in the hope that it would give guidance to all foundries, and all foundries did not have the advantage of control by Mr. Young. That probably made the difference between the consistent success described and troubles of the types which might have been experienced in ordinary foundries.

MR. YOUNG interposed to say he thought that hardly fair. Many foundries in Europe and America were melting high-steel charges in 1914 but he was not in charge of more than two of them.

Continuing, MR. BRAIDWOOD said the foundry which was melting steel for the first time would be well advised to bear in mind the recommendations made in the Report. Similarly, the ordinary foundry would be enabled, thereby, to use greater quantities of steel without serious risk of trouble.

Utilisation of Swarf

MR. FLEMING, concerning the "Utilisation of Swarf," section (*d*), "inclusion in cupola charges as a portion of the charge," asked if the sub-committee had any practical experience of that, or whether it was a deduction from other people's work. His own experience was that it was an entirely futile proceeding.

MR. BRAIDWOOD explained that the following points should be noted. The possible procedure which Mr. Fleming mentioned was the least desirable in the opinion of the sub-committee. Moreover, it was clearly stated that use should be made in such circumstances of briquetted, canistered or conglomerated material only, that is, no use should be made of loose swarf. Moreover, in no case should the proportion of swarf in the charge exceed 20 per cent. Members of the sub-committee had personal experience of such practice and there was quite a volume of well-authenticated published information which could be quoted in support.*

MR. FLEMING said the results they achieved were not hopeless technically, but they were hopeless economically; his own tests were made under complete laboratory control and supervision with some five technically-trained "lab." men recording all operations in addition to the normal furnace crew, and he was just as definite about the results using canistered material.

MR. TWIGGER asked whether blast-furnace managers welcomed the use of turnings? If they did, he thought the market price of turnings would be higher than it was at present. Another point was iron loss in connection with the melting of borings either in canisters, or briquettes, or loose. It would make an important difference to the economic side of the operation if a large proportion of the charge happened to find its way onto the neighbouring roofs.

MR. BRAIDWOOD said that careful enquiries had been made about the suitability of swarf for inclusion in the blast-furnace burden. It had been reported to be quite suitable and the sub-committee was confident that the best place for swarf was indeed the blast furnace.

MR. F. C. PEARCE said he calculated there were something like 13,200 words, 5,000 figures and 69 references to other works on the cupola, and then he thought of the poor foundryman having to go through all that. All they had to do was to build a stack, put a bottom in and some coke and some iron and some wind and get iron melted. He wondered whether the time had not come when they ought to receive some new directions. It was a terrific business to have to consider all the report to melt a bit of iron.

PROFESSOR O'NEILL had told them that the first foundrymen in this country were Irishmen and there were still foundrymen in that country. One had recently turned to the use of a direct-arc electric furnace; supplying molten iron from a cupola, and at the same time had put in cast-iron turnings or swarf, which they found an economic proposition. Since swarf was found everywhere where there were foundries, would not that be a new outlet—the direct-arc furnace in conjunction with the cupola—for using it up? It was well known in Ireland, England and America that 25 per cent. turnings could be put into a direct-arc furnace with excellent results. That was one outlet, were there any others which the sub-committee could have given them?

He noticed they had set out to prepare a report and recommendations on the best methods of utilising available materials. It did not follow that only cupola practice was the best method.

In reply, MR. BRAIDWOOD asked if Mr. Pearce really thought it fair to suggest that one must read the whole Report before one began to melt iron? The sub-committee had been set up to give guidance to the whole foundry industry and had had to discuss all possibilities. In each case they had listed these in order of preference. Much, however, depended on circumstances. The Report actually stated (page 8, col. 2, para. (*a*) of the Preprint) that the most satisfactory method of effecting recovery of swarf in the foundry was to melt in suitable electric furnaces.

The sub-committee, however, could not recommend small foundries to put in electric furnaces to melt their turnings, which might amount to only two or three cwts. per week. It had to be realised that circumstances altered cases. Electric-furnace melting of

*Mr. Braidwood misheard the question and assumed Mr. Fleming to have said "Item (*c*)." The answer at the time was based on this misconception. In subsequent semi-private conversation, the error was realised and the above answer then given.

swarf was a sound proposition in foundries making, for example, centrifugally-cast liners, for which alloy irons were used and from which much metal was converted into turnings. In the ordinary foundry, however, the procedure would be quite uneconomic.

He hoped it would be remembered that the Report had been drafted with the aim of covering every possibility, and of giving to any foundryman who was in difficulty, guidance which would best suit his particular circumstances.

MR. REYNOLDS said he was wholeheartedly in agreement with the Report. For 40 years he had been in the foundry and during that time they had melted high-duty grey alloyed irons, plain and alloyed steel-mix irons, and the like, and it would be impossible for him or his foremen to impart to those who would come after them all that they had learned. He could only cover the broad lines, but he thought the Report in the hands of their successors—and it would apply to a good many foundries in the country—would give them something to rely on, and save a lot of the headaches that he had to put up with in the early days. He was heartily in favour of the Report.

Using Foundry Scrap

A MEMBER agreed and thought the sub-committee was to be congratulated on the Report. In particular, he thought the Report would be of use to a great many foundries where there was no metallurgist or laboratory control. Quite a number of cases came to mind where he had been asked for details of charges, and so on. In such cases the information contained in the Paper would be of great value.

It was difficult to suggest means to enhance its value because it so fully covered the subject. He felt rather diffident in putting forward two points, one in the nature of a practical hint rather than a criticism. On pages 3 and 4 of the Preprint, the collection and breaking up of scrap was mentioned. He thought they could not have that mentioned too often. At present it was brought to their notice in many different directions not only in the technical but also in the daily Press. Of course, even though they had that hammered at them for so many years they still saw around their various workshops and foundry sites plenty of scrap. It was not enough to have an initial spurt, the necessity for keeping it up must be remembered.

The question of breaking-up scrap occasionally puzzled some foundrymen. He did not know whether the sub-committee had considered the question. In larger firms where they had hydraulic power and could use a hydraulic pig-breaker, that eased the question, but it was not so easy to deal with some pieces of scrap.

His second point was with reference to the notes for guidance on the use of steel scrap on pages 6 and 7 of the Preprint. He did not think there was shown any preference, but while there was detailed guidance on the use of swarf he found no reference to the use of steel scrap from press work, for example, all the pressings of automobile bodies. Some years ago, press scrap used to be baled-up into sizes about 18 in. long; he did not know whether that still went on. There had been some difficulty in finding a press suitable for it, and he believed in the end a German press was found to be best. Could that scrap be made into a form of conglomerate as was mentioned on page 9 of the Preprint?

MR. BRAIDWOOD said that breaking of massive scrap was indeed a matter of some difficulty. Where considerable quantities of heavy scrap were in use, it paid to put down really good equipment, for example, a soundly-constructed pit served by magnet crane handling a heavy ball. Wherever dismantling of scrap was practicable that should be done. On page 6, col. 2, of the Preprint it was stated that light-section steel scrap with a high ratio of surface area to mass should be directed to the blast furnace or open-hearth furnace, and so, also, should baled scrap. From the experience of its members, the sub-committee did not recommend the use of baled scrap in cupola charges.

THE CHAIRMAN (Mr. Colin Gresty), in closing the meeting, said he was sorry time would not permit him to let the discussion go on. As it was obviously such a controversial subject, he hoped it would be possible for members of the sub-committee to present it to several branch meetings, where all the points could be dealt with.

While, perhaps, not accepting all the recommendations of the sub-committee, he did think they had dealt with the subject in a very full and competent way but, as it was so controversial, they naturally had to expect a fair amount of criticism. In the meantime, he expressed the thanks of the meeting to Mr. Braidwood and his colleagues on the sub-committee for the work they had done, and he hoped they would continue it at branch meetings.

Written Comment

MR. V. C. FAULKNER, past president, wrote:—The adverse criticisms raised during the discussion of the Report have been shown to be without a significant basis, because the FOUNDRY TRADE JOURNAL has made available in the form of a chart the charge-calculation tables incorporated therein. As a result, there has been a demand for several hundreds of copies emanating from many of the largest foundries in this country and America.

I.A.E.S.T.E.

These letters are the initials by which the International Association for the Exchange of Students for Technical Experience is known. The second annual report received from the secretary, Mr. J. Newby, of the Imperial College, South Kensington, London, S.W.7, announces that the number of students exchanged rose from 920 in 1948 to 1,236 this year. About 150 British firms support the scheme and of these about 30 possess foundries. Readers who can receive or desire to place students during their long vacations would do well to write to Mr. Newby.

Book Reviews

Metals Reference Book. Edited by Colin J. Smithells, M.C., D.Sc. Published by Butterworths Scientific Publications, Limited, Bell Yard, Temple Bar, London, W.C.2. Price 61s. 3d., post paid.

For generations engineers have had available "pocket-books" which have so outgrown themselves that they have ceased to be easily portable. With these and more pretentious publications, the engineer has indeed been well catered for, but not so the metallurgist. Now this has been remedied by the appearance of this ponderous tome. The section devoted to foundry practice, which rather unfortunately starts off with "casting defects," carries no fewer than 37 tables, all of which are useful. In a book of 735 pages, it would perhaps be easier to refer to omissions rather than contents, for it is indeed comprehensive. Outstanding is the omission of any data relative to the cupola, though crucibles are fully covered. Then there are in general two few references to the processes connected with traditional metallurgy, though modern conceptions are fully dealt with. This may have been a fixed policy as such matter is taken care of in early works, as, for instance, Skelton's "Economics of Iron and Steel." The Editor was probably wise, as already the contents list covers nine pages.

Apart from the expected headings such as fuel, refractory materials and the like, there are sections covering line spectra of the elements, X-ray crystallography, geochemistry, equilibrium diagrams, gas metal systems, and controlled atmospheres for heat treatment. In many cases there is a bibliography at the end of each section so that, if need be, extended reference can be had on the subject covered. Considering that much of the matter is given in the form of tables and graphs, the price charged for the book is quite reasonable, and the reviewer strongly recommends its purchase by all metallurgical establishments, as a real time-saver—incidentally the conversion table for thermometer scales is easily the best we have ever seen—and what it purports to be—a metals reference book.

V. C. F.

Atlas of Defects in Castings—Revised and Enlarged Edition. Published by the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3. Price 21s. (to members 7s. 6d.).

There is sufficient difference between the first and this edition to render the former completely obsolete. Practically double the number of illustrations have been incorporated. The matter is well-balanced, as between the ferrous and non-ferrous castings. Many fresh examples of defects in die-castings and in steel components are included.

This new and enlarged form of the Atlas is, in a way, much less dangerous than the earlier effort. When there were but forty-or-so illustrations, a pugnacious buyer might misuse the book to attempt to condemn a consignment of castings. With increased size, the layman would be merely bewildered. In any case, it is not the sort of work to put into the hands of laymen, except, perhaps, designers. For the actual foundryman, it is very good value for money. It will help materially towards standardisation in nomenclature, in diagnosis and remedy. Because of these factors, the reviewer unhesitatingly recommends its purchase by all foundrymen.

Report on the Bessemer Process. By a Sub-committee of the British Iron and Steel Research Association. Published by the Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1. Price 25s. (members 15s.).

This 80-page paper-bound book covers, in three distinct sections, the history and present state of the technique of making steel by the Bessemer process and its various modifications. Unlike earlier works on this subject, direct and unusually-complete references are made to the actual works operating the processs. Moreover, so far as this country is concerned, the committee actually visited all the large-scale producers and two firms using the side-blown modification. The Report is quite up to date, and contains an account of the experiments with oxygen-enriched blast for the side-blown vessel. Providing economic conditions do not intervene to make competitive processes for steel-making more attractive, this book will establish itself as a major and essentially-practical work of reference.

V. C. F.

New Catalogues

Bending Machines and Iron Cement. Major, Robinson & Company, Limited, "Scols" Works, Warwick Road South, Manchester, 16, has recently issued a loose-leaf binder describing the company's products. Very wisely a map of Manchester is included showing the location of the works. Maps are always excellent publicity. The firm has a neat little emblem for its trade mark, yet this catalogue instead of emphasising this wherever possible has included a rather inane-looking much "overalled" individual. This 40-page catalogue is well indexed, laid out and illustrated. Most of it is devoted to descriptions of tube bending, cropping, shearing, punching, bar-bending (including gagger-bending) machines. Then to finish there are a few pages devoted to iron cements, pipe-jointing compounds and aluminium fillings.

Treadplates. An eight-page leaflet dealing with "positive-grip-pattern" treadplate has been received from the British Aluminium Company, Limited, of Salisbury House, London Wall, London, E.C.2. The product lent itself to what might be called the "new look" in engineering trade literature. By "new look" is meant a repetitive design on the front cover. Two specifications are suggested to cover various applications, and data is given to guide users as to choice and design for installation. The finished job, like the catalogue, has a pleasing and businesslike aspect.

Surface Roughness of Castings*

By G. Hobman†

Dimensional accuracy of castings is regarded as important by both the foundry and the consumer, but suitable tolerances have not been defined. The tendency is to narrow tolerances on castings for numerous purposes, and complaints of inaccuracies as small as 0.02 in. are not novel. And when tolerances are small, surface finish has an important bearing on measurement.

Surface Meter

To evaluate the surface roughness of castings, a simple direct-reading instrument of the stylus type is required, together with a classification system for various degrees of surface roughness found in commercially-produced castings. A "surface meter" has been developed (Fig. 1) which meets foundry needs, and those of customers, in that it is direct-reading, portable, withstands rough usage, is low in cost and is non-destructive in operation. It consists of a tripod support with the contact points machined to $\frac{1}{16}$ in. (with flat bottoms) to prevent rocking when placed on the casting, and also to prevent penetration of surface irregularities. The operating disc carries a gramophone needle offset 0.079 in. from centre, so that rotation of the disc will cause the needle to traverse a circle $\frac{1}{2}$-in. dia. Fifty graduations around the disc enable the operator to traverse the needle in 0.01-in. increments. Vertical movement of the stylus is indicated by a dial-gauge reading in 0.0005- or 0.0001-in. divisions.

* Reprinted from "American Machinist."
† Meehanite Metal Corporation, New Rochelle, New York.

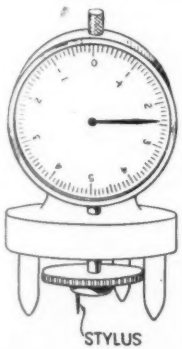


FIG. 1.—SURFACE METER FOR DIRECT MEASUREMENT OF SURFACE ROUGHNESS AT RIGHT ANGLES TO THE SURFACE PLANE.

Method

The instrument is held in contact with the casting while the disc is lifted, rotated and lowered progressively from division to division. Dial-gauge readings are recorded for the respective increments of stylus traverse. By graphical representation it is then possible to produce an enlarged impression of the surface explored. The results are considered typical for the area of the circle described by the stylus. Of course, absolutely identical results will not be obtained if the test is repeated on the same location, but the differences in readings are minute and general characteristics of the surface are unaltered.

TABLE I.—*Typical Recording of Roughness Data (using Random Zero on Dial-gauge).*

Reading number.	1 Reading in thous.	R Mean value 9.6. 2 Deviation from mean of 9.6.	3 Square of deviation.
1	7.5	2.1	4.41
2	6.5	3.1	9.61
3	8.6	1.0	1.00
4	6.8	2.8	7.84
5	10.1	0.5	0.25
6	15.9	6.3	38.90
7	13.1	3.5	12.25
9	10.4	0.8	0.64
10	7.8	1.8	3.24
40	13.0	2.4	11.46
42	11.6	2.0	4.00
43	7.0	2.6	6.36
44	7.5	2.1	4.41
45	10.5	0.9	0.81
46	11.0	1.4	1.96
47	11.6	2.0	4.00
48	12.4	2.8	7.84
49	10.3	0.7	0.49
50	10.0	0.4	0.16
Sum of squares (mean 9.6)			400.80
Mean square			8.02
Roughness (root-mean-square)			R2.8

Assessment of Results

Surface-finish measurements are made in terms of the average height (H-ave.) of the crests and roots in relation to a centre line and in terms of root mean square of the average height (H-rms.) of crests and roots above or below a centre line. Using the surface meter, readings of ordinates are taken at 0.01-in. increments and recorded (col. 1, Table I). Deviations from the mean value are tabulated in col. 2. To obtain the root mean square values, the deviations are squared (col. 3) and the square root of the mean square is obtained. In the example, the mean square is 8.02 and the square root or H-rms. is 2.8.

To classify surface roughness in simple terms, the symbol R is taken to indicate surface roughness, followed by a number indicating the H-rms. value in thousandths of an inch. Thus, R1.8 denotes an H-rms. value of 0.0018 in.

Surface Roughness of Castings

Ranges in surface roughness can be grouped in six classifications that cover all normal ranges of surface roughness at present encountered and also finer surfaces should they be produced in the future. These six

TABLE II.—*Classification of Surface Roughness.*

Class.	Symbol.	Range of roughness H-rms. values in thous.
O	R¼	Zero ro 0.250
A	R½	0.251 to 0.500
B	R1	0.501 to 1.000
C	R2	1.001 to 2.000
D	R4	2.001 to 4.000
E	R8	4.001 to 8.000

classifications are listed in Table II. Surface roughness ranges are arranged on a logarithmic basis to provide a smaller range in each class as the roughness decreases. Variations in skin finish will occur at various parts of the casting, but the R value will fall within the range; that is, within 50 to 100 per cent. of the magnitude of the maximum value. However, when a core is used to form one face of a casting and green or dry sand another face, the two faces should be reported separately. In reporting a casting, the nomenclature will be for example: "R1.2—Class C," the first figure giving the actual surface roughness.

Very Rough Surfaces

In the case of the rougher skin finishes—upwards of R1.5—it is not necessary to read and record stylus readings for the 50 increments of traverse. One merely operates the needle in contact with the sample for one complete revolution, estimating, meanwhile, the mean value of the dial-gauge readings. Then, the gauge-zero is set to this mean value and readings are recorded for the various increments of traverse. Finally, the readings are squared, the sum of the squares is divided by 50 and the square root of this figure is obtained. For finishes up to R1.5, 25 readings suffice.

New Foundry Film Strips Available

The Council of Ironfoundry Associations in its October General Bulletin (No. 47) announces that it has produced two film strips covering the moulding and casting of large iron castings for marine engineering. One strip outlines the making of a low-pressure turbine cylinder casing and the second a gearcase cover. The photographs were taken in the Clyde foundry of Harland & Wolff, Limited, and illustrated a Paper which gained for its author—Mr. D. H. Young—the British Foundry Medal. There are 26 frames in each strip; they are being sold by the C.F.B. at 12s. 6d. each. As usual, there is an appropriate little "sermon" to go with each strip.

AT A MEETING of professional engineers held in Manchester on October 28, convened by the Engineers' Guild, it was agreed to establish a North Western Branch of the Guild with headquarters in Manchester.

Piston Material

In a Paper which Mr. J. L. Hepworth, B.Sc.(Eng.), presented to the Automobile Division of the Institution of Mechanical Engineers, last Tuesday, he included a short section on piston material, which reads:—

The most suitable aluminium alloy for an oil-engine piston is still to be finally agreed; many alloys are available for which claims of superior physical properties at elevated temperatures are made, and while such alloys may be desirable for aircraft and other high-specific-output engines, they are not necessarily of value for commercial use. The Author has seldom seen pistons which failed through lack of tensile strength or fatigue resistance, or through creep, yet he has seen thousands which were worn out. In deciding upon an alloy, therefore, it seems best to choose the one with maximum wear and scuff resistance, provided that it has the strength to withstand the load conditions.

Wear testing cannot be carried out with any degree of certainty in the laboratory, and one has to rely upon service test results. After comparing many alloys under such conditions, the conclusions reached are that the 12 per cent. silicon alloy is outstandingly good for wear and scuff resistance. This material, in the cast state, possesses all the desirable features of a bearing material, and in addition has a coefficient of thermal expansion some 20 per cent. less than any of the low-silicon alloys. For maximum life, the material is die-cast to ensure fineness of grain, and fully heat-treated to develop the optimum physical properties. Figures have been published suggesting that the 12 per cent. silicon alloy has relatively poor strength. Given correct foundry technique, this material shows better strength than Y-alloy at temperatures up to 240 deg. C., and this temperature is seldom exceeded in the load-carrying portions of an oil-engine piston.

Industrial Output in August

The index number of industrial production (1946 = 100), prepared by the Central Statistical Office, is estimated provisionally at 119 for August last, which compares with a revised figure of 117 for the previous month. Figures for the corresponding months of last year were 110 and 112, respectively. Annual holidays, of course, affect the figures for both July and August.

The index number for the mining and quarrying industry in August last was 97, against 99 in July. The respective figures for the corresponding months of 1948 were 95 and 96.

German Foundry Practice

The German foundry journal, "Die Neue Giesserei," by an arrangement with Professor Piwowarsky, is periodically publishing supplements covering recent research work. Professor Piwowarsky is officiating as Editor. The first one, dated September, 1949, carries two Papers on cupola practice and five on various phases of graphite in cast iron. This first issue is of a really high-grade character—despite some corrigenda in the Paper—and no doubt it will be worth the extra payment demanded.

The Crown Proceedings Act

Actions Possible Against the State

By F. J. Tebbutt

The Crown Proceedings Act, 1947, which is now fully operative, is a measure of particular interest to firms and individuals, having in mind the part the State takes in trade and industry nowadays, and in general affairs. This Act recognises that the individual should be able to establish rights against the State in the same circumstances that one person can against another person. Roughly, the Act places the Crown (*i.e.*, the Government) in the matter of legislation in the same position as the subject, so that a person who desires to bring an action against the Government may proceed as though he were proceeding against another subject, and the new law applies to both contracts and torts (N.B., a "tort" is a matter of injury irrespective of contract).

Liability for Both Torts and Contracts

Before this Act, the position has been that the Government could not be sued as regards a tort in the courts and, as regards contracts, no action could be brought as of right, but only by the special process of Petition of Right. For this, permission of the Crown was required, that is it should have been operative by fiat of the Attorney General (N.B., "fiat," here, is an order from a superior to a lesser officer). The Act under review now states that, where any person has a claim against the Crown and the claim might have been enforced subject to the grant of His Majesty's fiat by Petition of Right, the claim may be enforced as of right by proceedings taken against the Crown, and without the fiat.

Moreover, the Act lays down that the Crown is subject to all those liabilities in tort to which, if it were a private person of full age and capacity, it would be subject. Thus, it is liable in respect of torts committed by its servants or agents (provided that the act or omission by the servant, etc., would have given rise to a cause of action in tort, if considered apart from the provision of the Act). Such action would have the same relative applicability as those in respect of any breach of those duties which a person owes to his servants or agents at common law by reason of his being their employer; and in respect of any breach of the duties attaching at common law to the ownership, occupation, possession or control of property. The Act specifically lays down that if the Government exceeds its rights as regards a patent or design (*e.g.*, it can use a patent and vend or buy goods in some cases), civil proceedings can be instituted against the Crown.

There are some exemptions where the Crown is outside this Act. No claim can be sustained against the Crown or its servants or officers in some cases of the Services, for instance, claims by one service man against another service man for injury while on duty. But such actions as slander, false imprisonment, excessive jurisdiction of a court martial, can be undertaken, not only against the soldier or officer, but now against the Crown. Proceedings in tort cannot be taken against the Crown, for anything done or omitted by any Post Office employee in respect of a postal package or a telephone communication, but, on the other hand, proceedings can be taken against the Crown in respect of loss or damage to a registered postal packet (not a telegram) due to a wrongful act done or of any neglect or default committed by a Post Office employee. Compensation in such cases will be payable at the market value of the packet, but the amount nevertheless will be dependent on the amount of the registration-fee paid.

Sundry Matters

Actions can be brought—in the High Court or the County Court—either against the department concerned or against the Attorney General if more than one department is concerned or there is a doubt as to which department is in fault. Where there are proceedings in the High Court or the County Court to which the Crown is a party, the Court may require that documents must be produced, and that the Crown must answer interrogatories, that is if the public interest is not likely to be injured. If public interest is involved a Minister can certify that that is so, but he can only so act if he considers that the public interest overweighs the ordinary principle of disclosure.

Imprisonment for debt—a power the Crown has always had if not now always exercised—is abolished, except in cases of non-payment of death duties or purchase tax, moneys in connection with which are considered as being received as if the recipient were a trustee. Space prevents listing the details of all sections of the Act, but the various provisions make clear that, except in the cases mentioned, the Government is now practically in a similar position to an ordinary individual or firm, and claims can be enforceable through the Court against the Government (i.e., the Crown) the same as if the matter was one between two private individuals or firms.

Census of Production

An order prescribing the matters about which returns may be required for the census of production to be taken in 1950 in relation to the year 1949 has been made by the Board of Trade to come into operation on December 31, 1949. The order exempts undertakings covering the production of coal, gas, electricity, oil-shale, crude or refined petroleum or shale-oil products from making returns to the extent to which they supply such information to the Minister of Fuel and Power. The title of the order is "The Census of Production (1950) (Returns and Exempted Persons) Order, 1949" (S.I., 1949, No. 2053), copies of which may be obtained from H.M. Stationery Office.

MR. DOUGLAS SHARP has been appointed deputy chairman of the Scottish Machine Tool Corporation, Limited, in succession to MR. H. OSBOURNE BENNIE, who will retire at the end of December.

Gas in Aluminium and its Alloys

Writing in "Revue de Métallurgie," Mr. R. Castro and Mr. M. Armand have set out their conclusions as regards gas in aluminium and its alloys in the following statement:—

Condition of Gas in Aluminium.—The only gas seeming to show a measure of solubility in liquid aluminium is hydrogen, and even this is of a low order, when 1,000 deg. C. is reached (a few ml. per 100 gms.). Moreover, this decreases when the temperature is lowered and becomes negligible at the melting point. On all accounts, the fall in solubility during the passage from one state to another is not large. Apart from dissolved hydrogen, nitrogen, in the form of nitride and oxygen, as alumina (skin or grains of corundum), can be found. In the liquid state, water vapour can be adsorbed into the internal or external surface of the metal.

Origin of Gas in Aluminium.—The origin of gas in aluminium is generally to be found in the reactions with the atmosphere with which it is in contact—reactions which are favoured to a greater or lesser extent by the presence of certain elements in the alloys or, maybe, by impurities and by temperature. In particular, the presence of sodium in the liquid metal or high superheat favours the decomposition of atmospheric humidity and, therefore, the appearance of hydrogen and alumina.

Action of Gas on the Properties of the Metal

Action of Dissolved Gas.—The existence of a fall, though small in magnitude, in the solubility during the passage from the liquid to the solid state leads to blowholes and intergranular porosity, which can cause cracking and are, in any case, detrimental from the point of view of mechanical strength.

Action of Combined Gas.—The presence of aluminium films or nitrides in suspension in the liquid is followed by a lowering of the "life" of the liquid metal and, therefore, by founding difficulties. The existence of grains of corundum included in the solid metal causes the rapid blunting of cutting tools.

Action of Gas Adsorbed in the Surface of the Metal.—According to the theory of Kliachko, water adsorbed by the internal or external surface of the solid metal is a source of defects. Thus, it would appear that water is the most dangerous factor in the metallurgy of aluminium. It is therefore essential to restrict to the greatest possible extent its influence, either by preventive measures, such as the use of perfectly-dry raw materials; the elimination of elements favouring the absorption of gas (sodium); the storage of the metal in a dry atmosphere, etc., or by ameliorative means, which consist of the elimination of hydrogen, alumina, and adsorbed water.

THE PAPER "Pattern Jigging on Moulding Machines," by H. Haynes, printed in last week's FOUNDRY TRADE JOURNAL, was presented to the Falkirk Branch of the Institute of British Foundrymen on September 30.

Securing Metal Sections in Wooden Core Boxes

By "Checker"

Incorporating metal pieces on wooden patterns and core boxes, to give additional strength and protection for thin sections, is nowadays the usual practice when large-quantity production is required. Considerable thought must at times be given for obtaining the best

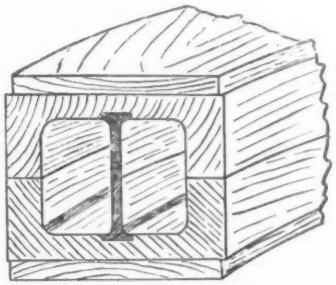


FIG. 1.—SECTION THROUGH CORE BOX.

method to secure these metal pieces, especially when they are of such thickness that satisfactory holes for screws cannot be drilled through their depth. Such an instance arose with a wooden core box which required a central rib to be fitted in both halves (see section in Fig. 1). This could not be satisfactorily made in wood which, owing to its frailty, would be of insufficient strength to stand up to the normal usage received in the core shop. It was therefore produced in aluminium, fillets being incorporated in the base, which was "let in" flush with the wood.

FIG. 2.—EXTENSION BOSS TO SECURE RIBS.

To secure these ribs, extension bosses (one on each side) were provided (see Fig. 2) in the centre; screws at each end were also necessary, provision for these being made by extending both ends sufficiently beyond the rib and fillet. When fitting metal pieces into the core box it is imperative that their bottom face should be true and level to give a correct foundation for seating the rib, and also to facilitate the matching-up of each half-rib on the core-box joint.

Notes from the Branches

Wales and Monmouth—West Wales Section

The opening meeting of the West Wales Section of the Wales and Monmouth Branch of the Institute of British Foundrymen was held at the works canteen of Richard Thomas & Baldwins, Limited, Landore. Mr. Gordon Rees, presiding, welcomed the presence of Mr. Cole, the president, Mr. Amos, the vice-president, and Mr. Wall, honorary secretary of the parent branch. In his opening remarks he expressed the opinion of the officers of the section that, in view of the small attendance on the occasion of their election, it would be advisable for them to resign and allow this meeting to submit nomination for all the positions.

On the motion of Mr. Jenkins, seconded by Mr. Hughes, it was unanimously agreed that the whole of the officers be re-elected. They had started very well, said Mr. Jenkins, and had the confidence of the members. Mr. D. O. Lewis thought that Llanelly was well represented and suggested that Swansea should have increased representation. Accordingly Mr. Jenkins and Mr. Turner were elected to the Section Council.

Mr. Rees reported that Mr. D. Rogers had expressed a desire to relinquish the position of secretary owing to failing health, but had agreed to continue at least to the end of this year. He was sure all those present appreciated the work Mr. Rogers had done and hoped that he would be able to continue for some time.

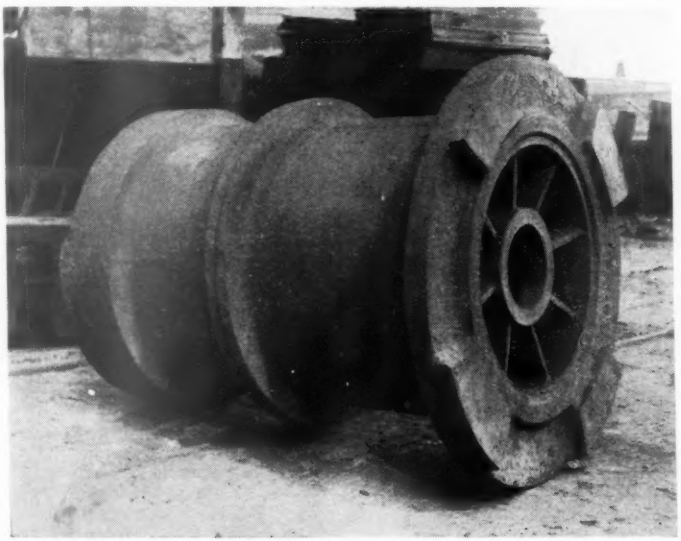
The meeting was then addressed by Mr. W. H. Hornby, of the East Midlands Branch, who presented a Paper describing the Moulding and Casting of an Evaporator Body, illustrated with a series of lantern slides. An interesting discussion followed, in the course of which Mr. Hornby dealt with questions to everyone's satisfaction, and the meeting concluded with a hearty vote of thanks to Mr. Hornby for his Paper.

Newcastle-upon-Tyne

The second meeting of the session of the Newcastle-upon-Tyne Branch of the Institute of British Foundrymen took the form of a works visit. Over a hundred members took the opportunity of inspecting the Walkergate works of C. A. Parsons & Company, Limited.

The success of this visit was ensured by the fact that the foundry is one of the most modern in the country. Members were able to see the latest developments in foundry equipment, adequately explained by guides. The ideal ventilation and lighting facilities were two of the principal attractions. The operation of the sand plant and the up-to-date methods of charging the cupolas, together with the labour-saving devices, received the whole-hearted approval of the visitors.

The firm very kindly provided tea for the members. A vote of thanks to the directors, management and all who helped to make the visit one of education and extreme interest to all foundrymen, was proposed by Mr. E. B. Ellis and seconded by Mr. S. Unsworth. Mr. W. D. Horsley, on behalf of the directors, replied and expressed his pleasure at being able to help further the interests of the Branch and the Institute as a whole.



The casting illustrated is a component for the largest and fastest strip mill in the world. No pinions are employed in the mill drive, each motor driving directly onto a roll; two motors are used on a two-high mill. Motor speed is 55 r.p.m. at 6,000 h.p., transmitted through the armature-hub centre and 26-in. dia. shafts to the rolls. The casting is 46 in. barrel dia. with a 62-in. flanged end, is 6 ft. long and weighs 10 tons.

Each is produced under strict control and is subject to crack detection after preliminary grinding of the fillets. In addition to the normal tests, castings are examined by gamma-ray.

FIG. 1.—CARBON-STEEL ARMATURE-HUB CENTRE, CAST BY DAVID BROWN-JACKSON, LIMITED.

British Blast Furnaces in the September Quarter, 1949

These tables are published through the courtesy of the British Iron and Steel Federation.

Derby, Leicester, Notts, Northants, and Essex.

Name of firm.	In blast, October 1, 1949, making :—				Weekly average in blast.		Total built.	Furnaces relining.
	Hematite.	Forge and foundry.	Basic.	Total.	Sept., 1949, quarter.	June, 1949, quarter.		
Clay Cross	—	1	—	1	1	1	2	—
Ford Motor	—	1	—	1	1	1	1	—
Holwell Iron	—	3	—	3	3	3	5	1
Kettering Coal & Iron	—	2	—	2	2	2	2	—
New Cransley Iron & Steel	—	1	—	1	1	1	2	1
Renishaw Iron	—	2	—	2	2	2	2	—
Sheepbridge	—	1	—	1	0·4	1	1	—
Stanton Ironworks : Stanton-by-Dale	—	5	—	5	5	3·6	5	—
Staveley Iron & Chemical	—	3	—	3	3·9	3·8	4	—
Stewarts and Lloyds : Corby	—	—	4	4	4	4	4	—
Wellingboro' Iron	—	1	1	2	2	2	3	1
Total	—	20	5	25	25·3	24·4	31	3

Lancashire (excl. N.-W. Coast), Denbigh, Flint, and Cheshire.

Brymbo Steel	—	—	1	1	1	0·9	1	—
Darwen & Mostyn	—	—	—	1*	1	1	1	—
Lancashire Steel Corp'n.	—	—	2	3†	3	3	4	1
Total	—	—	3	5	5	4·9	6	1

* Producing ferro-manganese. † Includes one producing ferro-manganese.

North-West Coast.

Barrow Ironworks	2	—	—	2	2	2	3	—
Charcoal Iron	—	1	—	1	0·6	0	1	—
Millom & Askam	2	—	—	2	2	2	3	1
United Steel: Workington	2	—	—	2	2	2	3	1
Total	6	1	—	7	6·6	6·6	10	2

Lincolnshire.

Appleby-Frodingham	—	—	8	8	8·8	9	9	1
Lysaght, J. : Scunthorpe	—	—	4	4	3·8	4	4	—
Thomas, R., & Baldwins : Redbourn	—	—	2	2	2	2	2	—
Total	—	—	14	14	14·6	15	15	1

North-East Coast.

Cargo Fleet Iron	—	—	2	2	2	2	2	—
Consett Iron	1	—	1	2	2	2	2	—
Dorman, Long : Acklam	—	—	3	3	3	3	4	1
Redcar	—	—	2	2	2	2	2	—
Cleveland	—	—	2	2	2	2	5	—
Bessemer	—	—	2	2	2	2	3	1
South Bank	—	—	—	2*	2	2	4	—
Grangetown	—	—	—	—	—	—	2	—
Gjers, Mills & Co.	2	—	—	2	2	2	5	—
Pease & Partners	2	—	—	2	2	2	3	1
Skinningrove Iron	—	—	2	2	2	2	2	—
South Durham Steel & Iron	—	—	2	2	2	2	3	—
Total	5	—	16	23	23	23	37	3

* Producing ferro-manganese

Scotland.

Bairds & Scottish Steel : Gartsherrie	1	1	1	3	3	3	5	1
Carron	—	1	—	1	1	1	4	1
Colvilles	—	—	3	3	3	2·8	3	—
Dixon's	—	2	—	2	2	2	6	1
Total	1	4	4	9	9	8·8	18	3

I.L.O. Metal Trades Committee

Among the items on the agenda for the third session of the I.L.O. Committee on Metal Trades, one of the eight industrial committees set up by the governing body of the International Labour Office to deal with conditions in certain major industries, which is due to open in Geneva on Tuesday next, will be a general report dealing particularly with the action taken in the various countries in the light of the conclusions of the second session, and recent events and developments in the metal trades. Vocational training and promotion together with systems of wage calculation, will also be discussed.

The British Government will be represented at the meetings by Mr. J. A. Diack, assistant secretary, Ministry of Labour and National Service, and Mr. C. J. A. Whitehouse, principal, Ministry of Supply. The employers' representatives will be Mr. A. C. Low, secretary of the Engineering and Allied Employers' National Federation, and Mr. W. Watson, secretary of the Shipbuilding Employers' Federation. Mr. R. Openshaw, a member of the executive council of the Amalgamated Engineering Union, and Mr. E. J. Hill, general secretary of the United Society of Boilermakers and Iron and Steel Shipbuilders, who is also a member of the General Council of the T.U.C., will be the workers' representatives.

Lancashire Foundry Trade

Lancashire textile engineering foundries are maintaining active working conditions and the demand for No. 3 pig-iron from this section is brisk. Foundries associated with the machine-tool section, as well as the gas and heavy electrical engineering trades, are also busy and there has been no contraction in the tonnage of iron being taken up. Although in some instances the pressure for deliveries is lighter, there is a good aggregate demand for pig-iron from the general engineering, jobbing, and light-castings section, the majority of which would gladly put iron into stock against possible winter contingencies if licences could be obtained.

Deliveries from the Derbyshire and Staffordshire furnaces are coming through regularly and the general supply position appears to be more comfortable. Stocks of foundry coke and other materials held by users are satisfactory.

S. W. Wise Memorial Award

It has been announced that the S. W. Wise Memorial Award is again to be presented to any member of the West Riding of Yorkshire Branch of the Institute of British Foundrymen who submits the best Paper on one of the specified subjects. Entries must be posted to the hon. secretary of the branch before January 1.

British Blast Furnaces in the September Quarter, 1949—*continued.*

Staffordshire, Shropshire, Worcestershire, and Warwickshire.

Name of firm.	In blast, October 1, 1949, making:— Hematite.	Forge and foundry.	Basic.	Total.	Weekly average in blast. Sept., 1949, quarter.	June, 1949, quarter.	Total built.	Furnaces relining.
Goldendale Iron	—	1	—	1	0·9	1	2	1
Lilleshall	—	1	—	1	1	1	2	1
Round Oak Steelworks	—	—	—	—	0·5	1	3	—
Shelton Steel & Iron	—	—	3	3	3	3	3	—
Stewarts and Lloyds: Bilston	—	—	3	3	3	3	3	—
Total	—	2	6	8	8·4	9	13	2

South Wales and Monmouthshire.

Briton Ferry Works	1	—	—	1	1	1	1	—
Guest, Keen, Baldwins: Cardiff	1	—	2	3	3	3	4	1
Thomas, R., & Baldwins: Ebbw Vale	—	—	2	2	1·9	2	3	1
Steel Co. of Wales: Margam	—	—	2	2	2	2	2	—
Total	2	—	6	8	7·9	8	10	2

Sheffield.

Park Gate Iron & Steel	—	—	1	1	1	1	2	—
GRAND TOTAL	14	27	55	100*	100·8	100·7	142	17

*Includes four making ferro-alloys.

Number of Furnaces in Blast on October 1, 1949

District.	Weekly average in blast, Sept. quarter.	Total in blast, October1, 1949.	In blast October 1, 1949, making:— Hematite.	Forge and foundry.	Basic.	Ferro-alloys.
Derby, Leics, Notts, Northants, and Essex	25.3	25	—	20	5	—
Lancs (excl. N.-W. Coast), Denbigh, Flint, and Ches	5	5	—	—	3	2
Lincolnshire	14·6	14	—	—	14	—
North-East Coast	23	23	5	—	16	2
Scotland	9	9	1	4	4	—
Staffs, Shrops, Worcs, and Warwick	8·4	8	—	2	6	—
S. Wales and Monmouth	7·9	8	2	—	6	—
Sheffield	1	1	—	—	1	—
North-West Coast	6·6	7	6	1	—	—
Total	100·8	100	14	27	55	4

Weekly Average Number of Furnaces in Blast during the Previous Six Quarters

District.	1949. June.	1949. March.	1948. Dec.	1948. Sept.	1948. June.	1948. March.
Derby, Leics, Notts, Northants, and Essex	24.4	25.6	25	25.6	25.7	25.4
Lancs (excl. N.-W. Coast), Denbigh, Flint, and Ches	4.9	5	5	5	5	5
Lincolnshire	15	14.2	14	13.5	13.8	13.7
North-East Coast	23	24	25 5	25.2	25.2	25.7
Scotland	8.8	8.2	9	9	9	9.1
Staffs, Shrops, Worcs, and Warwick	9	9	8.8	8	8	8
S. Wales and Monmouth	8	8	7.6	7.8	7.7	7
Sheffield	1	1	1	1	1	1
North-West Coast	6·6	7	7.2	6.3	6.4	7
Total	100.7	102	103.1	101.4	101.8	101.9

The following companies have furnaces in course of construction:—Darwen & Mostyn, 1; Lancashire Steel Corporation, 1; Steel Co. of Wales, 1; Sheepbridge Company, 1; Consett Iron, 1; Skinningrove Iron, 1; R. Thomas & Baldwins (Redbourn), 1; Barrow Ironworks, 1; Cargo Fleet Iron, 1; Lysaght, J. (Scunthorpe), 1.

Company Results

(Figures for previous year in brackets.)

UNITED STEEL COMPANIES—Final dividend of 5½%, making 8% (same).

JOHN BAKER & BESSEMER—Interim dividend of 15% on account of 1949. A single payment of 30% was made for 1948.

WOLVERHAMPTON DIE-CASTING COMPANY—Trading profit for the year ended June 30, £99,099 (£89,733); rents, £187 (£63); to depreciation, £23,398 (£22,823); audit fees, £263 (same); net profit, before tax, £75,625 (£66,710); taxation reserve not required, £4,973 (£2,835); brought in, £70,628 (£46,510); to taxation, £44,921 (£39,356); final dividend of 7½%, making 15% (same); forward, £100,234. A note states that directors' emoluments were £21,584 (£19,823).

WILLIAM DIXON—Consolidated trading profit to July 31, £144,313 (£134,537); investment income, £2,376 (£2,389); to depreciation, etc., £2,987 (£3,117); auditors' remuneration, £545 (same); repairs and improvements exceptional expenditure, £518 (£9,827); deferred repairs, nil (£4,523); staff pension scheme, £2,229 (nil), leaving £140,410 (£118,914); to tax, £72,429 (£74,535); dividend of 15% (same); past service pensions, £5,510 (£5,000); general reserve, nil (£18,000); forward, £103,260 (£51,589).

JOHN I. THORNYCROFT & COMPANY—Consolidated accounts to July 31 show balance brought in from trading, including £180,000 approximately in respect of delayed settlement of contracts completed prior to August 1, 1948, £930,188 (£702,829); other income, £3,208 (£3,385); to additional provision, for deferred repairs, £1,724 (£751); benevolent fund, £10,000 (same); depreciation, £110,006 (£99,924); audit, £1,700 (£1,678); directors' remuneration, £22,229 (£22,820); capital increase expenses, £1,500 (nil); taxation, £453,208 (£297,773); additional profits tax, nil (£17,055); leaving £333,029 (£256,213); brought in, £138,165 (£133,049); transfer from tax provision, nil (£3,200); to general reserve—John I. Thornycroft £200,000 (£175,000), subsidiary nil (£3,200); dividends, including profits tax applicable thereon—John I. Thornycroft, £71,400 (£76,097); forward, £199,794 (£138,165)—John I. Thornycroft £169,466 (£102,454), subsidiaries £30,328 (£35,711).

UNITED STEEL COMPANIES—Consolidated balance of trading profit for the year ended June 30, £3,767,659 (£3,935,651); income from trade investments, £317,832 (£354,399); income from other investments, £1,291 (£1,152); to directors' emoluments, £64,757 (£60,599); audit fees, £6,708; loan and debenture interest of subsidiary, £27,809 (£31,530); depreciation, £1,017,975 (£1,104,183); tax relief in respect of capital expenditure applied to provision for depreciation, nil (£260,500); pension schemes, £150,000 (£140,000); profits tax, £435,000 (£467,000); income tax, £952,000 (£1,302,000); tax relief in respect of capital expenditure applied to provision for deferred taxation, £571,123 (nil); leaving £3,225,372 (£3,372,315); after profits to outside shareholders of £13,292 (£9,307) and undistributed subsidiary profits of £21,110 (£20,733), the balance available to the parent company is £827,008 (£888,847); brought in, £613,485 (£606,696); to general reserve, £250,000 (£307,372); final dividend of 5½%, making 8% (same); forward, £615,807.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

LUTTERWORTH, November 17—Spun-iron pipes, cast-iron specials, and valves, etc., for the Rural District Council. Pick, Everard, Keay & Gimson, engineers, 6, Millstone Lane, Leicester. (Deposit, £2 2s.)

SOUTHPORT, November 16—Cast-iron railing standards, galvanised water tubing, etc., for the County Council. The Borough Engineer, Town Hall, Southport.

BURY ST. EDMUNDS, November 21—Supplying, laying, and jointing of 7,432 yds. of 12-in., 8-in., 6-in., and 5-in. class B spun-iron water supply feeder and pumping mains, etc., for the Borough Council. The Borough Engineer and Surveyor, Borough Offices, Bury St. Edmunds. (Deposit, £3 3s.)

New Patents

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed, and all subsequent proceedings will be taken.

619,589 FOUNDRY SERVICES, LIMITED, and WEISS, E. Production of iron castings.

619,596 MOREL, S. Sand-blast guns.

619,828 MORRIS MOTORS, LIMITED, BROWN, R. J., and BRIDLE, J. H. Quenching devices for use in the heat treatment of metal articles.

619,829 MORRIS MOTORS, LIMITED, and BRIDLE, J. H. Quenching devices for use in the heat treatment of metal articles.

619,991 METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, BENSON, L. E., and TURNBULL, J. S. Casting of metals.

620,071 INTERNATIONAL ALLOYS, LIMITED, and GROSS, P. Producing or refining metals.

620,120 BRISTOL AEROPLANE COMPANY, LIMITED, and TEDDS, D. F. B. Casting of metals.

620,138 BOSTROEM, T. Method and means for the thermal treatment of light alloys.

620,221 ROBIETTE, A. G. E., and HANCOCK, P. F. Recovery of metals from scrap.

620,366 HARVEY & COMPANY (LINDON), LIMITED, G. A. EATWELL, H. T., and SKINNER, A. J. Construction of pots for galvanising metals and means for heating same.

620,588 MILES & PARTNERS (LONDON), LIMITED, J., and MILLS, J. Removal of sulphur from coke and/or iron ore.

620,670 FORGES & ATELIERS DE LA FOULERIE. Moulds for casting metal articles.

620,705 BRITISH PISTON RING COMPANY, LIMITED, MONOCHROME, LIMITED, TWIGGER, T. R. and HALL, H. C. Electro-deposition of metal on the peripheral surfaces of rings or discs.

620,938 FEDERATED FOUNDRIES, LIMITED, CHAMBERLAIN, E. A. C., and BINNIE, R. T. Domestic open-close stoves.

621,016 BIRLEC, LIMITED, and ROBIETTE, A. G. E. Process of and electrical furnaces for melting aluminium or aluminium alloys.

621,260 MOND NICKEL COMPANY, LIMITED. Inoculants for cast iron.

621,269 NEW JERSEY ZINC COMPANY. Casting metal.

621,496 BIRLEC, LIMITED, and HANCOCK, P. F. Decarburisation of iron or iron-alloy castings.

621,553 WILD-BARFIELD ELECTRIC FURNACES, LIMITED, HAYWOOD, F. W., and LAIDLER, D. S. Case-hardening ferrous articles.

621,737 SHAW, C., SMITH, W. E., and GREENSMITH, D. E. B. Refractories.

621,985 SMIDTH & COMPANY AKTIESELSKABET, F. L. Treatment of limestone.

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

McDONALD FURNACES, 85-6, Darlington Street, Wolverhampton—£5,000. J. McDonald.

B.I.P. ENGINEERING—£100,000. C. Hassey, 30, The Chilterns, Brighton Road, Sutton, subscriber.

C. F. BOOTH, Old Sheffield Road, Rotherham—Scrap-metal merchants, etc. £10,000. C. F. and K. F. Booth.

BIRMINGHAM REFRACTORIES (CASTINGS), 27, South Road, Northfield, Birmingham, 31—£2,000. D. and S. Pitt.

COPE, WHELON & COMPANY, 98, Kings Road, Reading—Engineers, founders, smiths, etc. £10,000. E. G. Whelon, W. J. and S. H. Cope.

CRITERION MALLEABLE (WREXHAM), Criterion Foundry, Wrexham Trading Estate, Wrexham—Malleable-iron founders, etc. £10,000. E. M. Smith.

CURTIS PADWICK & COMPANY, Eldon Lodge, Worthy Road, Winchester, Hants—Agricultural machinery engineers, etc. £10,000. D. J. Curtis, K. W. Padwick, and H. R. Wieck.

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PROMPT DELIVERY

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New Electro-polishing Unit for Metallurgical Specimens

While electro-polishing of metallurgical specimens for micro-examination is not new, much interest is being taken in a new compact unit which electro-polishes and electro-etches an iron or steel specimen in about 20 to 30 seconds. The entire cycle, from the moment a specimen has been prepared by grinding a flat surface on it until it has been polished, etched, washed in alcohol and dried takes about three minutes. On most steel samples, the etching may be performed electrolytically in continuance of the polishing, simply by turning a switch a few seconds before the polishing time is up. In other cases, a simple device permits an electrolytic after-etching with other electrolytes without exchanging the liquid in the equipment. The apparatus works off the mains, and, with a rectified potential of about 45 v., the instrument uses a current of up to 1.5 a. for polishing, and up to 0.15 a. for etching. Various masks in plastic control the area of polishing. (Another model, called the "Micropol," is designed to polish only a very small area, of the order of 1.5 sq. mm.) Untrained personnel can learn to use the equipment in a matter of minutes. The period for polishing is preset on a small time control. Satisfactory results have been reported on test with numerous metals and alloys including carbon, alloy and special steels, cast iron, malleable and aluminium- and copper-base non-ferrous alloys. The larger unit is about 12 in. by 14 in. by 17 in. in size, and areas of about 100 sq. mm. can be treated. Both are of Danish origin, being produced by Struers Laboratories, Copenhagen. Information on the equipment may be obtained from Laboratory Equipment (London), Limited, 23, Sidmouth Mews, London, W.C.1.

Colchester Firm's Anniversary

Sir Harry Railing, chairman of the General Electric Company, Limited, was guest of honour at a dinner held to celebrate the 40th anniversary of Woods of Colchester, Limited, an associated company of the G.E.C. It is now the largest single works in the world specialising solely in the complete manufacture of propeller and axial-flow fans, including the electric driving motors. The founder was one of the pioneers of a.c. fan motors and one of the first to recognise that fans needed specialised types of motor.

Woods of Colchester, Limited, to-day produces some 70,000 fans annually. Since the war it has concentrated on export trade. In 1948 it exported one-fifth of the total exports of industrial fans from this country.

The Electron Microscope

Now available in the form of a booklet (of over a hundred pages) are the various Papers to be submitted for a symposium on the subject of metallurgical applications of the electron microscope. This function, organised by the Institute of Metals, in association with a number of other bodies, is to be held at the Royal Institution on November 16.

Personal

MR. F. C. EVANS has been made a Fellow of the Institution of Metallurgists.

MR. GUY SMITH has been appointed a director of Newton Bros. (Derby), Limited, manufacturing electrical engineers.

MR. KENNETH YOUNGHUSBAND and MR. L. C. SALTER have been appointed directors of John Summers & Sons, Limited, steelmakers, of Shotton, Chester.

MR. JAMES A. MCINTOSH has taken up the position of development manager with Lane & Girvan, Limited, Caledonia Stove & Iron Works, Bonnybridge, Scotland.

MR. W. B. WALLIS, the president of the Pittsburgh Lectromelt Furnace Corporation and immediate past-president of the American Foundrymen's Society, arrived in London last Saturday and returns to America to-day.

MR. H. A. BONNEY, a director and general manager of Follsain-Wycliffe Foundries, Limited, Lutterworth, near Rugby, has been appointed managing director of the company, and MR. W. J. PROCTOR, sales manager, has been elected to the board.

SIR PHILIP JOHNSON, managing director of R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-upon-Tyne, was elected chairman for 1949-50 of the National Association of Marine Enginebuilders at its annual general meeting held in Edinburgh recently. MR. T. A. CROWE, engineering director of John Brown & Company, Limited, Clydebank, was elected vice-chairman.

Obituary

MR. ERNEST COWELL, test-house superintendent at the Sheepbridge Coal & Iron Company, Limited, Chesterfield, for 38 years, has died at the age of 58.

MR. EDWARD R. STETTINIUS, former United States Secretary of State and former chairman of the United States Steel Corporation, died last week. He was 49.

MR. I. PEARSON, managing director and founder of I. Pearson & Sons, Limited, mechanical and electrical engineers, of Doncaster, died on October 25. He was 70.

MR. THOMAS DAVIDSON SANDERS, joint managing director of Thomas Sanders, Limited, builders' brass-founders, etc., of Ladywood, Birmingham, 16, was found dead in a car on October 27.

MR. ARTHUR DEBOO died recently at the age of 81. Mr. Deboo, who was with John Wheeler & Sons, Limited, ironfounders, of Langley, Oldbury, Birmingham, for 65 years, started with the firm as an office boy and retired as works manager only three years ago.

MR. GEORGE LINDSAY, who has died at the age of 74, was for many years managing director of Charles Lindsay, Limited, hearth-furniture manufacturers, of Glasgow; the company was founded by his father. Mr. Lindsay was also chairman of the Carmuirs Iron Company, Limited, Falkirk, from 1923 to 1947.

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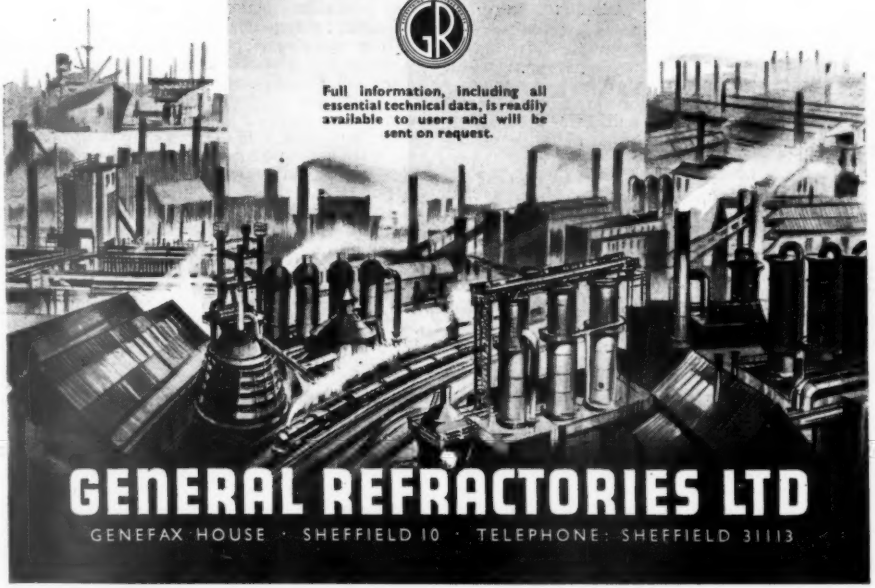
Full information, including all essential technical data, is readily available to users and will be sent on request.



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Raw Material Markets

Iron and Steel

A state of approximate equilibrium between production and consumption of pig-iron seems to have been achieved. For some months past consumers have been working on very narrow margins and there have been times when foundrymen have been compelled to use other than the particular grades required for furnace mixtures. But deliveries from the blast furnaces are now coming forward more satisfactorily and the position generally is no longer precarious. Makers of light castings are fairly busy at present, but the outlook is clouded by the threatened curtailment of the housing programme which must inevitably lessen the demand for domestic castings. Engineering establishments, on the other hand, have no reason to fear an immediate recession and, consequently, they are taking up full quotas of hematite and low- and medium-phosphorus irons.

Most classes of semi-finished steel are now plentiful, and as the tempo of operations at the re-rolling mills has slackened, defective billets, crops and re-rolling scrap are not disposed of easily. Sheet bars and slabs, however, are in steady demand and sheet-mill capacity is taxed to the full; there is still a scarcity of small 2-in. billets.

There is no sign of recession in the steel-plate trade. Indeed, the current demand far exceeds the supply and equitable distribution has been complicated by the issue of allocations in excess of the mills' capacity. Orders for heavy sections, joists, and channels also amount to an impressive total, and it is not thought likely that the threatened cuts in capital expenditure will have any substantial effect. Makers of light bars and sections are encountering keen French and Belgian competition in overseas markets, but outputs of black and galvanised sheets and of wire rods are quite inadequate fully to satisfy immediate requirements.

Non-ferrous Metals

Last Friday saw an increase of £13 in the price of copper to £153 per ton and, although some upward adjustment had been feared, the market was taken by surprise. The rise followed an increase of nearly 1 cent. per lb. to 18½ cents in the United States and a further advance in the American quotation is not improbable. October deliveries are expected to be at a higher level than for a long time past, and it is perhaps remarkable that no adjustment of the U.S. copper price occurred earlier.

The parity of 18½ cents is £148 per ton, so consumers in Britain are securing their copper relatively more cheaply than before devaluation. The new price level in the United Kingdom is deplored by the trade, which realises clearly enough that £153 is bound to put something of a check on demand for the metal. Once again the question is asked, what would be the course of prices if the market were free and the London Metal Exchange in operation?

Figures issued by the British Bureau of Non-ferrous Metal Statistics show that September usage was a marked improvement on August, for consumption of virgin copper in the United Kingdom rose from 24,913 tons to 29,509 tons. Secondary copper usage increased, too, from 13,162 tons to 14,575 tons. Stocks showed a small reduction on the August total of 149,950 tons. For the first nine months of the year deliveries of virgin copper totalled 238,725 tons, which is a decline of some 30,000 tons compared with 1948.

In zinc, stocks at September 30 stood at 73,862 tons, which is about 2,000 tons lower than a month earlier. In lead, a similar position obtains, for the August figure of 65,217 tons declined to 63,394 tons at September 30. Consumption of lead (30,818 tons) was, however, some 4,000 tons better than the preceding month.

It has been reported that a draft tin scheme has been prepared by the Working Party of the Tin Study Group, which embodies a control agreement, and comments on the position and outlook for the tin industry. The metal is certainly in over-supply, although stocks in this country, which are considerable, are in strong hands.

"Bedding-in" or "Turn-over"?

By "Chip"

Most castings can be made in a variety of ways, but the pattern supplied is usually constructed to favour one particular method of manufacture. It is always wise for the patternmaker to consult the moulder before commencing the pattern when alternative methods are possible, as different shops may make the same job by different methods. A patternshop supplying a number of foundries should make sure that the equipment supplied is the most suitable to the conditions pertaining. Thus, one shop with adequate lifting facilities may produce a job easily by the "turn-over" method, whereas another may be obliged to "bed-in."

For castings such as large sole- or bed-plates, with large, flat surfaces carrying numerous facing pieces, facilities must be made on the pattern for adequately ramming the under surface, when bedding-in is resorted to. A pattern produced for the turn-over method, in which the surface is rammed direct, would not be suitable for the former method. Instead, a pattern is required in which parts of the face are removable so that the moulder can easily get at the underside and ensure that the facing pieces, etc., are rammed correctly.

On the other hand, a flimsy pattern, such as for a sole-plate, when moulded by the turn-over method, needs stiffening to resist deformation due to the "give" of the pattern which would probably produce an unsightly, if not a waster casting. Such stiffening can be obtained by making a rough frame structure which can be placed inside the shell pattern and so resist the tendency to deformation. This frame structure should be a part of all the pattern equipment supplied for castings similar to those under review.